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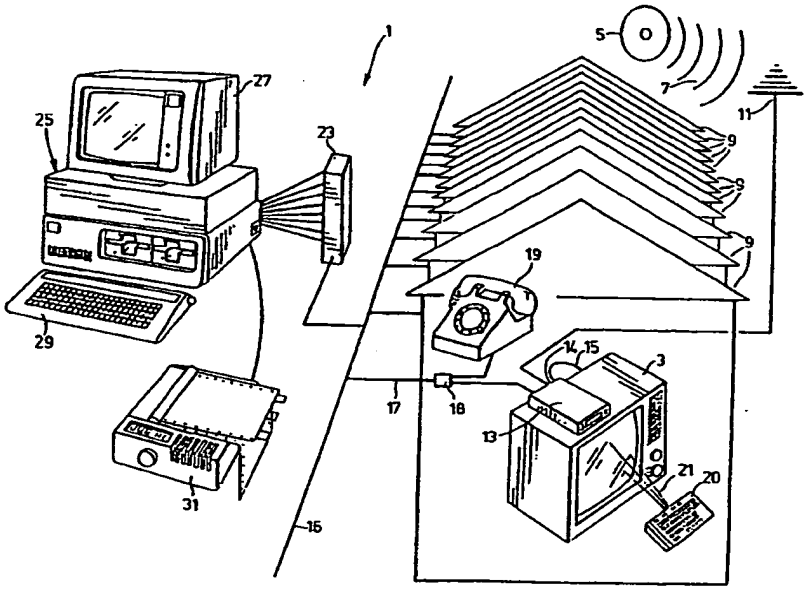

(57) Abstract

A system (1) for remotely displaying screen data on televisions (3) or the like transmits screen data over a plurality of commercial radio band carrier transmitters (5). A plurality of devices (13) are provided, each being for use with a corresponding television in a home. Each device includes a band receiver (33) and a decoder (35) for receiving and decoding screen data. A display signal is then generated for viewing on the television or the like. Each device can include means (20) for receiving responses from a user, for example responses to a program viewed. The device can also include a storage (51) for storing both screen data and response data. This enables response data to be transmitted at a later time, and it can be collected by polling from a central computer (25). Similarly, screen data can be received and stored, for later viewing.

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A SYSTEM AND DEVICE FOR DATA TRANSMISSION, AND RELATED METHOD

FIELD OF THE INVENTION

The present invention relates to a system for transmitting data and more particularly to the transmission of data for display in a remote location.

BACKGROUND OF THE INVENTION

Systems for transmitting data, collecting responses to that data and storing the responses in a form where the responses can be analyzed have long been a concern in the art. Such systems can, for instance, be used by polling and rating services. Many other uses such as accessing central database information systems will be evident to those who have worked in this area.

In the consumer field, such polls are used, for example, to determine consumer preferences for selected products, services, television programs or channels.

Research services have traditionally used several different methods in which to collect their responses. One of these methods is to send out questionnaires in the form of letters requesting

responses. This is very expensive and time consuming as the letters have to be addressed, sent, received, completed, returned, and then responses have to be manually analyzed or entered into a computer by the research company. Also, since a fair amount of time is required by the consumer to complete the response, response rates can be low and inaccurate. Another form of surveying is orally by telephone. The labour cost is high in performing the telephone calls and again manual calculation or entry of responses is necessary for the company.

Another traditional data collection method is to provide the participants in the surveys with diaries. The participants must keep track of what they watch or the products they use and enter their responses into the diary. The diaries are then collected and the responses are manually analyzed or entered into a computer. This is a very cumbersome procedure both for the participant and the company.

In the electronic age many systems have arisen in an attempt to simplify procedures for both the companies and the participants.

Bar code readers allow surveyors to keep track of products which have been coded with a universal product code. The response data read by the readers is stored in a data base which may be sold to companies interested in the products covered by the survey. In practice this system is normally non-discriminatory. For instance, if a bar code reader is placed in a grocery store normally all of the products coming out of the store are entered into the data base. Although this provides for a great deal of useful data it additionally stores a great deal of unusable data. The data base becomes

very large, expensive and cumbersome to use.

One system for determining television ratings is totally automated. A hardware device is hooked directly to and monitors the use of the channels of a television. The information is sent over a dedicated telephone line to a central computer. Although the system is fully automated the hardware implementation can be quite costly and only gives specific information related to the time of viewing, length of viewing and the channel viewed.

Systems for providing moment to moment audience responses to an event are particularly useful. Known systems require the event to be performed in a room equipped with devices enabling each participant to input his/her response, e.g. by means of buttons corresponding to different responses. The response data would be collected by a computer and combined with the known demographics of the viewers and synchronized to the event. Obviously this system requires the participants to travel to a central location. At the location the event is performed in a setting foreign to the participant which may alter the reliability of his or her responses.

It has been previously very expensive to do on-line telephone moment to moment audience surveys. For example, a dedicated telephone line would be needed for each member of the audience.

In the area of information systems present applications include accessing central data bases using a personal computer and a modem. The system operator creates and maintains a data base in a host computer and normally controls access via passwords issued to authorized users. While connected to the host computer, the users requests and the hosts

answers are passed back and forth through the telephone network. Users can be charged on a subscription and/or a connect time basis. This system facilitates access to an unlimited amount of data, however the system requires each user to invest in a personal computer, the software required to operate the computer and a modem.

Furthermore users must be educated in how to dial up, sign on, and search for the desired information. This system is more appropriate for sophisticated computer users with specialized, non-standard information needs.

Furthermore for mass dissemination of information the personal computer information systems require each user to access the central data base using a telephone line. This ties up the users telephone as well as the telephone system and requires the host computer to have a large number of access ports.

In order to simplify the personal computer system dedicated information access systems which are designed to be more user friendly have been developed. The user needs only to enter numeric responses on a key pad to undertake a search. These systems have generally used graphics based screens requiring a lengthy drawing session for each screen. Also the receivers and decoders that were specially designed for the systems have costs well above mass market appeal. As for all user to host access systems, each user ties up a telephone line and a host computer access port.

Another information system transmits its information in a normally unused portion of the vertical blanking interval of a regular television signal. A viewer must be equipped with a special

decoder to view the information. A severe constraint of the vertical blanking interval systems is the limited bandwidth. Typically, a loop of pages is transmitted. If the access time is to be reasonable only a limited number of pages can be transmitted.

Other systems have employed the cable television service available in most cities throughout North America. Unfortunately not all homes are provided with basic cable service. Very few homes are provided with two-way cable systems eliminating interactive applications.

Some information systems have employed the FM band for transmitting information. None of these systems has incorporated an interactive return path component. Additionally some of these systems are designed to transmit only small data bursts on an irregular basis as opposed to maintaining an open channel for continuous delivery.

SUMMARY OF THE INVENTION

In a first aspect the invention provides a system for remotely displaying screen data as screens on viewing apparatus, the system comprising: a plurality of commercial radio band carrier transmitters, each of the transmitters encoding and transmitting screen data on differing commercial radio band carriers; and a plurality of devices each being for use with a corresponding viewing apparatus and comprising a band receiver adapted to receive an encoded band carrier and including a band tuner for tuning the band receiver to a selected band carrier, a band carrier decoder connected to the band receiver, the band carrier decoder being adapted to decode the screen data from the received band carrier, and a display signal means connected to the

band carrier decoder, the display signal means being adapted to produce from the screen data a display signal representing the screens to be displayed; whereby each viewing apparatus when connected to the display signal means of a respective device accepts the display signal and displays the screens.

In the second aspect the invention provides a device for use in an interactive system for remotely viewing screen data as screens on a viewing apparatus, the screen data being encoded and transmitted on one of a plurality of commercial radio band carriers, and for remotely transmitting responses from a viewer as response data to a central computer via a response data encoded telephone carrier, the device comprising: a band receiver adapted to receive the encoded band carrier, and including a band tuner for tuning the band receiver to a selected band carrier; a band carrier decoder connected to the band receiver, the band carrier decoder being adapted to decode the screen data from the received band carrier; and a display signal means connected to the band carrier decoder, the display signal means being adapted to produce from the screen data a display signal representing the screens to be displayed; a response data input means, including a viewer control means, the response data input means accepting responses from the viewer and translating the responses into response data; and a first telephone carrier encoder connected to the response data input means, the telephone carrier encoder being adapted to encode a telephone carrier with the response data; whereby a viewing apparatus when connected to the display signal means accepts the display signal and displays the screens; and the

response data can be transmitted to the central computer by the telephone carrier encoder when a telephone line is connected between the telephone carrier encoder and the central computer.

In a third aspect, the invention provides a method for remotely displaying screen data as screens on a viewing apparatus, the method comprising: encoding and transmitting screen data on differing commercial radio band carriers; tuning and receiving a selected band carrier; decoding the screen data from the selected band carrier; and producing from the screen data a display signal representing the screens to be displayed; whereby the screens may be displayed on the viewing apparatus when the viewing apparatus accepts the display signal.

As an alternate aspect of the present invention, instead of the presence of multiple transmissions of commercial radio band carriers, there can be provided, in each device, a storage means for storing both responses and screen data. This is applicable to the system, the device and the method of the present invention.

The provision of a storage for screen and response data has many advantages. For screen data, it enables the user or viewer to instruct the later recordal of favoured information segments. These can be viewed at a time suitable to the viewer. This can also give the user rapid access to the selected segments and relieve pressure on the overall capacity of the system.

Storing response data relieves demands on a common telephone line. It can further enable response data to be automatically uploaded by a central computer. This can either be done on the

viewer's instructions, or the central computer can sequentially poll a number of installations or households to collect the information.

The commercial radio band transmitters preferably use a subcarrier in the FM radio band 88-108 MHz. Alternatively, the carrier could be in the VHF or UHF television band frequencies and the cable television frequencies 54-450 MHz.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, which show a preferred embodiment of the present invention, and in which:

Figure 1 is a schematic diagram of the major components of an interactive polling system;

Figure 2 is a block diagram of the internal data and address path structure of a polling device employed in the polling system of Figure 1;

Figure 3 is a block diagram of Figure 2 with the major control signals of the polling device added.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention will be described with relation to its application as a polling system, however it is to be understood that the invention is not limited to this use. Other embodiments within the scope of the invention could among other things include applications for travel reservation, advertisement, real estate listing, pay TV per program and home shopping services.

Reference will now be made to Figure 1 in describing an overall interactive remote polling system 1.

The system 1 is designed to display a questionnaire in the form of a series of screens on a viewers television 3. Other viewing apparatuses, such as a monitor, may be employed, but a television would be most commonly used as almost every home has one. Once source of the screens which are to be ultimately displayed on the television 3 is one or more FM broadcast stations 5 (shown schematically). The screens are transmitted in the form of FM band carriers of different frequencies encoded with screen data, as indicated by the radial lines 7. The screen data is typically comprised of, but not limited to, text characters. The use of text screens lessens the amount of screen data which is required to be transmitted and, as we shall later see, stored and/or displayed. Alternatively, the FM carrier may be transmitted through an FM cable system, not shown.

Although the preferred embodiment has been limited to FM band carriers, the present invention is not limited to FM band carriers, but can be designed to employ any commercial radio frequency carriers.

The FM band carriers will be picked up by the antennas 11 on a number of chosen homes 9. The antennas 11 are connected each to a respective polling device 13 within each of the homes 9. Additionally, the subscribers standard broadcast television signal comes through a cable or antenna connection system 14 to the polling device 13.

The screen data transmitted on the FM band carriers can be addressed to an individual polling device 13 or broadcast to all the polling devices 13 in each of the homes 9. The screen data transmitted on the FM band carriers can be transmitted multiple times in order to ensure that it is received

correctly by the polling devices 13. As an alternative, the screen data can be transmitted as a continuous loop, which the polling device 13 can enter at any time.

The polling device 13 is connected to the subscribers television 3 through a connector 15.

An alternate source of screens, and a response communication link, for the polling device 13 is the genera. telephone system 16 connected through the subscribers telephone line 17 and a dual telephone socket 18. A telephone 19 for the subscribers use is also connected to the subscribers telephone line 17 through the other socket of the dual telephone socket 18.

An infrared transmitter 20 is coupled by infrared signals, shown by lines 21, to the polling device 13. The infrared transmitted 20 is the means by which a viewer can control certain functions of the polling device 13 and the system 1. The actual amount of control over the system 1 for the infrared transmitter 20 will depend on the specific application of the system 1. For instance, when the system 1 is a remote polling system the transmitter 19 may be able to turn the device 13 on, choose the source of the screens, and input responses to the questions appearing on the screens. The transmitter 20 has 28 buttons for cursor control, numerical entry and other general and specific functions.

Also connected to the general telephone system 15 through a modem 23 is a central computer 25. Although not shown, the central computer 25 is additionally connected to the FM broadcast stations 5 to control the routing of screen data to the FM band carriers of the broadcast stations 5. The scheduling

of the broadcasting of screen data encoded FM carriers is also controlled by the central computer 25. The screen data is transferred as a continuous data stream to the FM broadcast stations 5 over high speed dedicated transmission lines. At each broadcast station 5 an addressable control unit modulates and encodes the screen data for that station onto the particular FM band carrier for that station 5.

Depending on the amount of information to be processed by the computer 25 it may be a personal computer 25 as shown. The computer 25 has connected to it a monitor 27, a keyboard 29 and printer 31 for monitoring and manipulating the information contained therein.

Reference will be made to Figure 2 in describing the internal data and address path structure of the polling device 13 for one home 9.

As stated, the screen data enters the device 13 from the FM antenna 11 or through the telephone line 17. The FM antenna 11 is connected to an FM receiver 33. The FM receiver 33 is connected to an FM decoder 35, which is then connected to a multiplexor 37.

The other source of screen data, the telephone line 17 is connected through a relay 38 and a transformer 39 to a modem 41. The modem 41 used in the preferred embodiment was a full duplex 1200 band modem 41. The modem is then connected to the multiplexor 37. The modem 41 has associated circuitry, not shown, which is capable of sensing an attentuation in a signal being transmitted from the modem 41. The attenuation when sufficient is assumed to be caused by the viewer's telephone 19 going off-hook. When the telephone 19 is off-hook the

modem 41 disconnects from the subscriber's telephone line 17 to allow the subscriber to use the telephone 19. This feature saves the cost of having to install a dedicated telephone line for the device 13 as for most interactive prior art systems. The connection may be made again at a later date to continue transmission.

The multiplexor 37 is connected to a microprocessor 43 through a universal asynchronous receiver/transmitter (UART) 44.

A direct connection is provided from the UART 44 in the microprocessor 43 to the modem 41 to allow response data to be transmitted to the central computer 25 through the modem 23 from the UART 44. The microprocessor 43 used in the preferred embodiment was an 80C31, but other microprocessors having similar capabilities as described herein would be suitable.

An infrared receiver 45 is capable of taking input in the form of response data from the infrared transmitter 20. The infrared receiver 45 is connected to the microprocessor 43.

The microprocessor 43 is connected to an electrically erasable programmable read only memory (EEPROM) 46. The EEPROM 46 stores the telephone number of the modem 23 at the central computer 25, an encoded address of the home 9 in which it is situated and a password. The material is stored in the EEPROM 46 in case of a prolonged power outage.

The microprocessor 43 is also connected to an address and data bus 47 through a number of general purpose input/output (I/O) registers 48 in the microprocessor 43. For the system 1 described the address portion of the bus was sixteen bits wide

while the data portion was eight bits wide. Also connected to the bus 47 are a 32K read-only memory (ROM) 49, a 128K random access memory (RAM) 51, a latch 53, a video display generator 55, and an address decoding and integrated circuit selection circuitry 56. The latch 53 is further connected to a light emitting diode (LED) display 54 having 5 LED's, not shown. The emissions of the LED's are shown by the arrows 57.

Each of the components in the polling device 13 is powered by a power supply 58. The power providing connections have not been shown in any of the figures as they are conventional and showing them would unduly complicate the figures. The power supply 58 is plugged into a typical home 60Hz supply line. The RAM 51 is battery backed-up by a battery 59 in case of a power outage.

In addition to providing power, the power supply 58 provides a 60 Hz square wave signal to the microprocessor 43, as illustrated by the connection in Figure 2. The microprocessor 43 has an internal time of day clock 60 which is updated by the square wave signal.

An address and data path 61 connects a video RAM 62 to the video display generator 55.

The video display generator 55 has red, green, blue, and sync signal outputs 63, 65, 67, and 69 connected to an NTSC encoder 71. The NTSC encoder 71 is connected through a radio frequency (RF) modulator 73 to a RF relay switch 75. The other input to the RF relay switch 75 is the standard broadcast signal through the antenna or cable connection system 14.

The output of the RF relay switch 75 is then output to the television 13 through the connector 15.

Reference will now be made to Figure 3. Figure 3 is similar to Figure 2 with the major control signals for the device 13 added.

The modem 41 is a 1200 bit per second full duplex modem 41. The modem 41 can modulate, encode, and send response data encoded telephone carriers. Additionally the modem 41 can receive, demodulate, decode and forward screen data from a screen data encoded telephone carrier. Response data for the modem 41 originates in the UART 44 and is sent through the transformer 39, relay 38, and the subscribers telephone line 17 to the general telephone system 15. Received screen data encoded telephone carriers are picked up from the general telephone system 15 by the subscribers telephone line 17 and sent through the relay 38, transformer 39, modem 41 and multiplexor 37 to the UART 44.

The modem 41 has three control signal lines: carrier detect 90, call progress tone detect 92 and squelch transmitter 94. The squelch transmitter signal 94 is used to turn the modem 41 on and off. When the modem 41 is turned on it can receive and transmit signals. The carrier detect signal 90 signals the microprocessor 43 that a data encoded carrier exists on the subscribers telephone line 17. The call progress tone detect 92 informs the microprocessor 43 when it dials a phone number if it is receiving a ringing signal or a busy tone from the dialed number.

The FM receiver 33 is controlled by a set of three signals from the microprocessor: SDO 98, SYNEN 100 and SYNCL 102. These signals 98, 100, 102 tune the receiver 33 to a desired band carrier frequency.

The source for the multiplexor 37 is controlled

by an FM receiver/modem select signal 104 from the microprocessor 43.

The EEPROM 46 can be read and written by the microprocessor 43. The reading and writing functions are controlled by EEPROM clock and EEPROM enable signals 106, 108. The enable signal 108 enables the EEPROM 46 to accept signals on the EEPROM clock line 106 and the serial data connection of Figure 2. The clock signal 106 allows the EEPROM 46 to be read or written, the command and the address are specified by the microprocessor 43 on the serial data connection. EEPROM write data will follow a write command on the serial data connection. The read EEPROM data is output to the microprocessor 43 by the EEPROM 46 through the serial data connections following a read command.

The circuitry 56 as its name suggests picks up addresses sent by the microprocessor 43 to the bus 47. The addresses are decoded by the circuitry 56. If the address belongs to the RAM 51, the video display generator 55 or the latch 53 then that chip 51, 53 or 55 is signaled.

The RAM 51 is signaled through a RAM select line 110. The RAM select line 110 is actually four lines, not shown, as the RAM 51 has four 32K memory chips, not shown, to make up 128K of memory.

The latch 53 is signaled by an output signal 112 connected to the enable input of the latch 53.

The video display generator 55 is signaled by a THOMEM signal 114.

When one of the chips 51, 53 or 55 is selected the address to be addressed in the chip 51, 53 or 55 is read from the bus 47. As the chip 51, 53 or 55 signaled by the signal line 110, 112 or 114 is not

enabled until after the address has been decoded by the circuitry 56, and only a portion of the address lines, not shown, of the bus 47 is employed in the circuitry 56, the other address lines, not shown, must be delayed by a delay flip flop, not shown, to arrive at the chip 51, 53 or 55 at the appropriate time.

The RAM 51 and the video display generator 55 are informed of the function they are to perform at the address specified on the bus 47, with the data which follows on the bus 47, by a read signal 116 or a write signal 118 from the microprocessor 43.

When the microprocessor 43 wishes the modem 41 to connect through the subscribers telephone line 17 and the general telephone system 15 to the modem 23 and the computer 25, the relay 38 is opened and closed to perform pulse code dialing. The relay 38 is controlled by a HK signal 120 from the latch 53. The HK signal 120 is addressed through the latch 53 by the microprocessor 43 as described above.

To select between standard broadcast television and the screens from the polling device 13, the RF relay switch 75 is switched between the signal from the RF modulator 73 and the standard broadcast television signal. The RF relay switch 75 is controlled by a screen/television signal 122 from the latch 53. The screen/television signal 122 is addressed by the microprocessor 43 through the latch 53 as described above.

A program, not shown, is stored in the ROM 49 and oversees the operation of the polling device 13. The ROM is signaled directly by the microprocessor over a programmable ROM select enable line 124 and addressed by the microprocessor 43 through the bus 47.

In operation, the polling device 13 can take on a number of different modes, four of which will be described. These four modes are on-line FM, on-line telephone, local FM and local telephone. As will become evident to those skilled in the art, other modes of operation are possible by combining various features of the four modes to be described.

In the on-line telephone mode the viewer uses the transmitter 19 to request the on-line telephone mode. The polling device 13 receives the request through the infrared receiver 45. The infrared receiver 45 amplifies the request and forwards it to the microprocessor 43. The microprocessor 43 will then dial the central computer 25. The dial operation will begin with the microprocessor 43 reading the phone number of the central computer from the EEPROM 46. The microprocessor 43 then opens and closes the relay 38 via the latch 53. When the modems 23 and 41 are connected the carrier detect signal 40 notifies the microprocessor 43. The microprocessor 43 then selects the telephone source for the multiplexor 37. Screen data is then encoded and forwarded from the central computer 25 through the modem 23 to the modem 41. The modem 41 decodes the screen data and forwards it to the UART 44.

The screen data is actually preceded by a data password from the central computer 25. The microprocessor 43 compares the password to the password in the EEPROM 46. If the password is matched the microprocessor 43 selects the video display generator 55 via the THOMEM signal 114, and signals a write operation via the write signal line 118. If the password is incorrect the screen data will not be recognized by the microprocessor 43. The

password feature ensures the actual recipient of screen data is the intended recipient and allows individual polling devices 13 to be selectively addressed.

The microprocessor 43 sends out the screen data from the I/O registers 48 over the bus 47 to the video display generator 55. The video display generator 55 stores the present screen in the video RAM 62. The screen in the video RAM 62 can be used to refresh the video display generator 55 if the screen data has not changed from the microprocessor 43 by the time the screen is to be over-written by the video display generator 55.

The output of the video display generator is in the video form of red, green, blue and sync signals 63, 65, 67, 69. The signals 63, 65, 67, 69 are NTSC encoded by the NTSC encoder 71. The RF modulator 73 modulates the NTSC encoded signal onto a given VHF television carrier. Usually the carrier will be one of channels 2, 3, or 4.

The microprocessor 43 through the latch 53 signals the RF relay switch 75 to send the display signal to the television 3 as described above.

Responses, if any, to the on-line screens are input through the infrared transmitter 20 by the viewer. The polling devise 13 receives the response data from the transmitter 20 through the infrared receiver 45. The infrared receiver 45 amplifies the response data and sends it to the microprocessor 43.

When responses are ready to be transmitted the microprocessor 43 signals the modem 41 to turn on via the signal 94. The response data is then transmitted over the response data path to the modem 41 directly from the microprocessor 43. The modem 41 modulates

the response data and sends it through the transformer 39 and the relay 38 to the central computer 25.

The central computer 25 records the responses and transmits further screen data depending upon the requirements of the questionnaire being completed and the responses received.

In the local telephone mode, the receiving of screen data is similar to that for the on-line telephone mode except the process is commenced at a given time on the clock 60 and not by the viewer.

At the given time the microprocessor 43 has the central computer 25 dialed up as described previously. The screen data is then sent all at once to the microprocessor 43.

The screen data is not immediately sent to the video display generator 55 for display, instead the microprocessor 43 selects, via the circuitry 56 and the RAM select signals 110, the RAM 51. The address in the RAM 51 is placed on the bus 47 from the I/O registers 48. The operation is a write specified by the write signal 118. The screen data to be written into the RAM 51 is placed from the I/O registers 48 onto the bus 47.

The use of text characters, as opposed to graphics, reduces the amount of information necessary to be stored by the RAM 51. As a result the RAM 51 may be a relatively small size while storing a relatively large number of screens. As discussed previously, the RAM 51 is 128k. This will hold approximately 600 screens although a portion of the RAM 51 is dedicated to storing response data when necessary. Previous systems in the art tended to use graphics information requiring large amounts of

transmitted data. Reduction in the amount of necessary RAM produces corresponding reduction in size and cost.

An LED on the LED display 54 may be caused to light up by the microprocessor 43 through the latch 53 as described previously. This makes the viewer aware that a questionnaire is resident in the polling device 13 for viewing.

When the viewer desires to have the screen displayed he or she does not have to wait for the screens to be received as the screens are already in the RAM 51. The viewer selects local telephone mode through the transmitter 20. The microprocessor 43 then selects the RAM 51, but this time requests a read operation via the read signal 116. The microprocessor 43 also selects the video display generator 55 and requests a write operation via the write signal 118. SCreen data from the RAM 51 is then written to the video display generator 55 by the microprocessor 43 over the bus 47. The present screen is stored in the video RAM 62 for refresh purposes as before.

Responses are input from the transmitter 20 as before, but are stored in the RAM 51 as response data in a manner similar to that for the incoming screen data.

Additional screen data is output for viewing on the television 3 according to the requirements of the questionnaire and the responses input by the viewer.

At a later time the response can be remotely read by the central computer 25. The microprocessor 43 at a given time on the clock 60 dials the central computer as described before. The microprocessor 43 then reads the stored responses from the RAM 51 and

sends them from the UART 44 to the central computer 25.

In the off-line FM mode the receiving of screen data is commenced at a given time on the clock 60 and not by the viewer. At the given time the microprocessor 43 tunes the FM receiver 33 to receive a pre-selected FM band carrier via the signals 98, 100, 102 and selects the FM input to the multiplexor 37 via the FM receiver/modem select 104. The FM receiver 33 receives the screen data encoded FM carrier and forwards it to the FM decoder 35. The FM decoder 35 decodes the screen data from the carrier and forwards the screen data to the UART 44 through the multiplexor 37.

As for the off-line telephone mode, all of the required screens for a given questionnaire are transmitted and stored in the RAM 51 along with the necessary branching information. Again, similar to the off-line telephone mode, one of the LEDs on the LED display 54 can be illuminated to indicate that screen data has been received and is now available for access. The further operation of the off-line FM mode is similar to that for the off-line telephone mode.

In the on-line FM mode the viewer employs the transmitter 19 to request on-line FM. The polling device 13 receives the request through the infrared receiver 45. The infrared receiver amplifies the request and forwards it to the microprocessor 43. The microprocessor 43 decodes the request, tunes the FM receiver 33 to receive the selected FM band carrier via the signals 98, 100, 102 and selects the input to the multiplexor 37 via the FM receiver/modem select 104. The FM receiver 33 receives the screen

data encoded FM carrier and forwards it to the FM decoder 35. The FM decoder 35 decodes the screen data from the carrier and forwards the screen data to the UART 44 through the multiplexor 37.

The screen data is displayed as screens on the television 3 as it is received in a manner similar to the operation in the on-line telephone mode.

The viewer responses to the screens viewed are stored in the RAM 51 in a manner similar to that for the on-line telephone mode. The response to each individual screen causes the microprocessor 43 to search for the next requested screen and to display that screen when it is received. The stored response data can be transmitted to the central computer 25 in a manner similar to that for the off-line telephone mode.

Moment to moment surveys tracking viewer responses and correlating the responses to an event occurring at a specific time may be performed using any one of the four modes described. This could either be done by the user providing a general moment by moment indication of the degree of satisfaction with a particular program, or by the user providing specific responses to a questionnaire. In practice the least expensive and most effective mode to employ would be one of the off-line modes. The material to be rated may be listened to on a radio station or viewed on the users television 3 with the polling device 13 periodically displaying screens with questions to be answered. When the material to be rated is a television program coming from the standard broadcast signal then the microprocessor 43 would switch the source of material to be displayed on the television 3 using the screen/television

signal 120 to switch the relay switch 75 between its two sources.

The responses from the viewer would be stored as response data along with the time at which the response was received. The central computer 25 can, at a later time, correlate the time of the response data with the time at which the event occurred to determine the moment to moment responses of the viewer.

The LED display 54 may be caused to light up in sympathy with the response data from the transmitter 19. For instance, a viewer may be requested to rate a television program on a scale from one to five. If the viewer responds through the transmitter 19 with a three, the microprocessor 43, in addition to storing the response in RAM 51, will light three of the LEDs in the LED display 54 through the latch 53. This could be done on a moment to moment basis throughout a program.

Often a questionnaire will be designed to run at the same time as the event or program. Thus, the screen data of the questionnaire can be time-stamped so that the microprocessor 43 will not allow access to the given screen data in the RAM 51 until a given time on the clock 60.

It should also be noted that whilst responses will often be stored in the RAM 51 prior to transmission, the responses can be forwarded to the central computer in an on-line mode.

Although the four modes were discussed with respect to telephone connections originated by the microprocessor 43, the modem 41 has the capability of detecting and recognizing a ring signal from an incoming call. The microprocessor 43 can close the

relay 38 to communicate with the source of the call, typically the central computer 25. Thus where the microprocessor 43 previously was described to dial the computer 25 it is possible to have the computer 25 dial the microprocessor 43. Instances where this may be desirable would be to transmit screen data to the microprocessor 43 at a time convenient to the central computer 25 and not at a time predetermined by the clock 60. Similarly, response data may be collected from the RAM 51 through the microprocessor 43 at a convenient time instead of at a time given by the clock 60.

The advantages of the polling device 13 and the polling system 1 over prior systems are evident. Screen data can come from either FM or telephone sources. The multiple transmission FM source allows for inexpensive mass transmission or the flexibility of addressing individual units through the password system. Multiple FM sources, on different frequencies, can be tuned in by the FM receiver allowing for multi-channel data. The on-line modes allow for the transmission of up-to-date screen data or screen data which would be otherwise too large for the capacity of the RAM 51 of the polling device 13. Off-line modes place the desired screens at the ready so that the viewer may view the screens at his/her own speed. The viewer does not have to wait for the screens to be transmitted at what may be a slower than desired rate due to any technical limitations on the rate of transmission. Additionally, as screen data is no longer on a loop transmission the viewer will enter at the beginning of a screen sequence and does not have to wait for the presently transmitting screen loop to finish to begin his/her questionnaire.

The use of the modems 23 and 41 combined with the infrared transmitter 19 as part of an input means allows the viewer to simply perform the manual input of responses. This saves the polling company from having to manually input all the responses into its computer 25. Thus the analyzing to be performed by the company can be performed by the computer 25 on response data previously entered by the viewer.

Additionally, the use of an off-hook sensing apparatus allows the device to be used in conjunction with the subscriber's telephone 17 saving the cost of a dedicated telephone line. Further, to enable screen data or response data to be transmitted remotely, a ring suppression means can be included, for suppressing ringing of the telephone, during such transmissions.

Moment to moment response surveys can be performed in the familiar setting of the viewers home.

It is to be understood that other embodiments of the invention will fall within its spirit and scope as defined by the following claims.

I CLAIM:

1. A system for remotely displaying screen data as screens on viewing apparatus, the system comprising:

a plurality of commercial radio band carrier transmitters, each of the transmitters encoding and transmitting screen data on differing commercial radio band carriers; and

a plurality of devices each being for use with a corresponding viewing apparatus and comprising a band receiver adapted to receive an encoded band carrier and including a band tuner for tuning the band receiver to a selected band carrier, a band carrier decoder connected to the band receiver, the band carrier decoder being adapted to decode the screen data from the received band carrier, and a display signal means connected to the band carrier decoder, the display signal means being adapted to produce from the screen data a display signal representing the screens to be displayed;

whereby each viewing apparatus when connected to the display signal means of a respective device accepts the display signal and displays the screens.

2. A system according to claim 1 further comprising, a central computing means connected to the band carrier transmitters, the central computing means being adapted to store and retrieve screen data and to route and transmit screen data to the band

carrier transmitters for transmission on the differing band carriers.

3. A system according to claim 2, further comprising, for each device a viewer control means coupled to the display signal means and capable of controlling when the display signal is produced.

4. A system according to claim 3, further comprising, data storage means connected to the band carrier decoder and to the display signal means, the data storage means being adapted to store screen data from the band carrier decoder and wherein the display signal means is additionally adapted to retrieve stored screen data from the storage means and the viewer control means is additionally coupled to the storage means for controlling selection of the source of screen data for the display signal means from the band carrier decoder and the storage means.

5. A system according to claim 4, wherein each device includes a processor unit connected to the respective band carrier decoder, display signal means, and storage means.

6. A system according to claim 3 or 4, wherein, for each device, the viewer control means is additionally coupled to the band tuner and is capable of controlling the band tuner to select a device band carrier.

7. A system according to claim 5, wherein, for each device, the viewer control means is additionally coupled to the band tuner and is capable of

controlling the band tuner to select a desired band carrier.

8. A system according to claim 7, for additionally remotely transmitting responses from viewers to the central computing means, the system further comprising:

for each device, a response data input means including the viewer control means, the response data input means accepting responses from the viewer and translating the responses into response data;

for each device, a first telephone carrier encoder connected to the response data input means, the first telephone carrier encoder being adapted to encode a first telephone carrier with the response data and send the encoded first telephone carrier;

a telephone carrier transmission means connected between the first telephone carrier encoders and the second telephone carrier receiver;

a second telephone carrier receiver associated with the central computing means and adapted to receive the first encoded telephone carrier;

a second telephone carrier decoder connected to the second telephone carrier receiver, the second telephone carrier decoder being adapted to decode the response data from the first telephone carrier;

wherein the central computing means is additionally connected to the second telephone carrier decoder;

whereby the response data can be transmitted to the central computing means by the first telephone carrier encoder over the transmission means through the second telephone carrier receiver and decoder.

9. A system as claimed in claim 8, wherein the storage means of each device is capable of storing response data for later transmission to the central computing means.

10. A system according to claim 9, the system further comprising:

a second telephone carrier encoder connected between the telephone transmission means and the central computing means and being adapted to encode and transmit screen data;

for each device, a first telephone carrier receiver being connected to the telephone carrier transmission means to receive a second encoded telephone carrier;

for each device, a first telephone carrier decoder connected to the respective telephone carrier receiver, which first telephone carrier decoder is adapted to decode the screen data from the encoded second telephone carrier; and

for each device, a decoder selector connected to the first telephone carrier decoder and between the band decoder and the display signal means, the selector selecting between the screen data from the first telephone carrier decoder and the screen data from the band carrier decoder.

11. A system according to claim 10, wherein, for each device, the viewer control means is additionally coupled to the decoder selector and is capable of controlling the decoder selector.

12. A system according to claim 11, wherein, for

each device, the telephone carrier transmission means is connected to the first telephone carrier encoder and receiver via a ring suppression means, for suppressing a ring signal received from the telephone carrier transmission means.

13. A system according to claim 9, 10 or 11, which includes, for each device, an off-hook sensing means connected between the telephone carrier transmission means and the first telephone carrier encoder, the sensing means being adapted to sense an increased load attenuation on the transmission means indicative of a conventional telephone receiver being lifted, and to disconnect the first telephone carrier encoder from the transmission means when such an increased load is sensed.

14. A system as claimed in claim 10, 11 or 12, wherein each device includes an indicator means for indicating the presence of stored screen data therein.

15. A system as claimed in claim 10, 11 or 12, wherein, for each device, the viewer control means forms a discrete, separate part of the device, and the other part of the device includes an indicator means, capable of indicating a response received from the viewer control means and the presence of screen data stored in the storage means.

16. A system as claimed in claim 5, 7 or 12, which includes a relay switch means having an input for a conventional television signal, an input connected to the display signal means, and an output connectable to a television providing the viewing

apparatus, the relay switch means being connected to and controlled by the viewer control means, for selection of the display signal means or the conventional television signal as the input to the television.

17. A system for remotely displaying screen data as screens on a viewing apparatus, the system comprising:

a central computing means;

a transmitter connected to the central computing means for transmitting screen data;

a plurality of devices each being for use with a corresponding viewing apparatus and comprising a receiver means adapted to receive an encoded carrier, a decoder means connected to the receiver means for decoding a carrier, a display signal means connected to the receiver means, for producing from the screen data a display signal representing the screens to be displayed, a response data input means including a viewer control means, the response data input means accepting responses from the viewer and translating the responses into response data, an encoder means connected to the response data input means, for encoding response data, a transmission means for transmitting encoded response data to the central computer, and a storage means for storing both screen data and response data.

18. A system as claimed in claim 17, in which each device includes a first telephone carrier encoder and a first telephone carrier receiver, and the central computer is provided with a second telephone carrier receiver and a second telephone

carrier encoder, and the system includes a telephone transmission means connected between the first and second telephone carrier encoders and receivers, whereby screen data can be transmitted to each device over the telephone transmission means, and response data can be transmitted over the telephone transmission means from each device to the central computer.

19. A system as claimed in claim 17 or 18, wherein each device includes an indicator means, for indicating at least one of the presence of screen data received and stored in the storage means and response data from a user.

20. A device for use in an interactive system for remotely viewing screen data as screens on a viewing apparatus, the screen data being encoded and transmitted on one of a plurality of commercial radio band carriers, and for remotely transmitting responses from a viewer as response data to a central computer via a response data encoded telephone carrier, the device comprising:

a band receiver adapted to receive the encoded band carrier, and including a band tuner for tuning the band receiver to a selected band carrier;

a band carrier decoder connected to the band receiver, the band carrier decoder being adapted to decode the screen data from the received band carrier; and

a display signal means connected to the band carrier decoder, the display signal means being adapted to produce from the screen data a display signal representing the screens to be displayed;

a response data input means, including a viewer control means, the response data input means accepting responses from the viewer and translating the responses into response data; and

a first telephone carrier encoder connected to the response data input means, the telephone carrier encoder being adapted to encode a telephone carrier with the response data;

whereby a viewing apparatus when connected to the display signal means accepts the display signal and displays the screens; and

the response data can be transmitted to the central computer by the telephone carrier encoder when a telephone line is connected between the telephone carrier encoder and the central computer.

21. A device according to claim 20, further comprising a screen data storage means connected to the band carrier decoder and to the display signal means, the screen data storage means being adapted to store screen data from the band carrier decoder, and wherein the display signal means is additionally adapted to retrieve stored screen data from the storage means and the viewer control means is additionally capable of controlling whether the source of screen data for the display signal means is the band carrier decoder or the storage means.

22. A device as claimed in claim 21, which includes a processor unit connected to and controlling the band receiver, the display signal means, the response data input means, the first telephone carrier encoder and the data storage means, and wherein the data storage means can additionally

store response data from the response data input means.

23. A device according to claim 22, wherein the viewer control means is coupled to the processor unit and to the display signal means, the viewer control means being capable of controlling when the display signal is produced.

24. A device as claimed in claim 23, which includes a relay switch means having an input for a conventional television signal, an input connected to the display signal means and an output for connection to a television, providing the viewing apparatus, the relay switch means being controlled by the viewer control means to select which input is connected to the output.

25. A device according to claim 20, 22 or 24, wherein the viewer control means is additionally capable of controlling the band tuner to select the selected band carrier.

26. A device according to claim 20, adapted for receiving screen data encoded and transmitted on a telephone carrier, the device further comprising:

a telephone carrier receiver adapted to receive the encoded telephone carrier;

a telephone carrier decoder connected to the telephone carrier receiver, the telephone carrier decoder being adapted to decode the screen data from the telephone carrier; and

a decoder selector being connected to the telephone carrier decoder and between the band

decoder and the display signal means, the selector selecting between the screen data from the telephone carrier decoder and the screen data from the band decoder.

27. A device as claimed in claim 24, adapted for receiving screen data encoded and transmitted on a telephone carrier, the device further comprising:

a telephone carrier receiver adapted to receive the encoded telephone carrier;

a telephone carrier decoder connected to the telephone carrier receiver, the telephone carrier decoder being adapted to decode the screen data from the telephone carrier; and

a decoder selector being connected to the telephone carrier decoder and between the band decoder and the display signal means, the selector being controlled by the viewer control means, whereby the selector selects between the screen data from the telephone carrier decoder and the screen data from the band decoder.

28. A device as claimed in claim 27, wherein the viewer control means can instruct the processor unit in advance, to store selected screen data in the storage means for later display.

29. A device as claimed in claim 27 or 28, which includes a ring suppression means, for suppressing the ringing of a conventional telephone, to enable response data to be retrieved from the storage means or screen data to be transmitted to the storage means over a telephone line associated with that telephone.

30. A device as claimed in claim 27 or 28, which includes a ring suppression means, for suppressing the ringing of a conventional telephone, to enable response data to be retrieved from the storage means, or screen data to be transmitted to the storage means over a telephone line associated with that telephone, and which also includes an indication means for indicating the presence of stored screen data in the storage means.

31. A device as claimed in claim 27 or 28, which comprises a main unit, and a separate discrete unit comprising the viewer control means, and wherein the main unit includes visual indication means for indicating a users responses.

32. A device as claimed in claim 27 or 28, which includes a ring suppression means, for suppressing the ringing of a conventional telephone, to enable response data to be retrieved from the storage means or screen data to be transmitted to the storage means over a telephone line associated with that telephone, and wherein the device comprises a main unit and a separate, discrete unit comprising the viewer control means, with the main unit including indication means for providing an indication of a users responses and the presence of screen data stored in the storage means.

33. A device as claimed in claim 27, which includes an off-hook sensing means for sensing when a telephone connected to the same telephone transmission line as the first telephone carrier encoder is in an off-hook condition, by sensing an

increased load attenuation, and to interrupt transmission of response data or receipt of screen data.

34. A device for use in an interactive system for remotely viewing screen data as screens on a viewing apparatus, the screen data being encoded and transmitted on a radio band carrier, and for remotely transmitting responses from a viewer as response data to a central computer via a response data encoded telephone carrier, the device comprising:

a receiver adapted to receive the encoded carrier;

a decoder connected to the receiver, and adapted to decode screen data from the received carrier;

a display signal means connected to the decoder, the display signal means being adapted to produce from the screen data a display signal representing the screens to be displayed;

a response data input means, including a viewer control means, the response data input means accepting responses from the viewer and translating the responses into response data;

a first telephone carrier encoder connected to the response data input means, the telephone carrier encoder being adapted to encode a telephone carrier with the response data; and

a storage means adapted to store both screen data for later display, and response data prior to transmission over the telephone carrier.

35. A device as claimed in claim 34, which includes a telephone carrier encoder connected to the

display signal means, with the display signal means selecting either the decoder connected to the receiver or the telephone decoder as the source for the screen data.

36. A device as claimed in claim 15, which includes a relay switch means having one input for a conventional television signal and another input receiving the display signal from the display signal means, and an output for connection to a television, providing the viewing apparatus, the relay switch means being controllable by the viewer control means, to select either the conventional television signal or the display signal for display on the television.

37. A method for remotely displaying screen data as screens on a viewing apparatus, the method comprising:

encoding and transmitting screen data on differing commercial radio band carriers;

tuning and receiving a selected band carrier;

decoding the screen data from the selected band carrier; and

producing from the screen data a display signal representing the screens to be displayed;

whereby the screens may be displayed on the viewing apparatus when the viewing apparatus accepts the display signal.

38. A method as claimed in claim 37, which includes storing screen data, and selecting as a source for the display signal one of the stored screen data and the screen data being received.

39. A method as claimed in claim 37 or 38, which includes the additional steps of:

accepting responses from a viewer of the viewing apparatus and converting the responses into response data;

encoding the response data onto a suitable response carrier;

transmitting the encoded response carrier;

receiving the encoded response carrier;

decoding the response data from the response carrier.

40. A method as claimed in claim 38 with the additional steps of:

accepting responses from a viewer of the display signal on a viewing apparatus, and converting the responses into response data;

encoding a first telephone carrier with the response data;

sending the encoded first telephone carrier;

receiving the encoded first telephone carrier;

decoding the response data from the first telephone carrier.

41. A method as claimed in claim 38, which includes the additional steps of:

encoding a second telephone carrier with screen data and transmitting the encoded second telephone carrier;

receiving the encoded second telephone carrier;

decoding the screen data from the encoded second telephone carrier; and

selecting between screen data decoded from the second telephone carrier, screen data decoded from the selected band carrier, and stored screen data.

42. A method as claimed in claim 41, which includes providing an indication to the viewer, when screen data is stored ready for use.

43. A method as claimed in claim 39, 41 or 42, which includes the prior selection of desired screen data for storage, which screen data are later automatically stored, for later viewing by the viewer.

44. A method as claimed in claim 40, in which response data are directly transmitted to central computing means.

45. A method as claimed in claim 40, which includes storage of the response data, prior to transmission via the first telephone carrier to a central computing means.

46. A method as claimed in claim 45, wherein the central computing means automatically uploads stored response data.

47. A method as claimed in claim 46, wherein the response data for each of a plurality of individual locations is stored at that location, and the central computing means automatically and sequentially uploads response data from the individual locations.

48. A method as claimed in claim 46, wherein the

viewer provides an instruction for later uploading of the stored response data by the central computing means.

49. A method as claimed in claim 44, 47 or 48, which includes a user providing a response which is a moment by moment response to viewed screens.

50. A method as claimed in claim 49, in which a visual indication is provided to the user of the moment by moment response.

51. A method as claimed in claim 44, 47 or 48, in which the viewer can instruct the later storage of desired screen data, for later viewing by the viewer, and in which an indication is given to the viewer of stored screen data.

52. A method as claimed in claim 44, 47 or 48, which includes the additional steps of:

at the central computing means encoding a second telephone carrier with screen data and transmitting the encoded second telephone carrier;

receiving the encoded second telephone carrier;

decoding the screen data from the encoded second telephone carrier; and

selecting between the screen data decoded from the second telephone carrier, the screen data decoded from the selected band carrier, and stored screen data, for generating the display signal, an indication being given of the presence of any stored screen data.

53. A method as claimed in claim 44, 47 or 48, which includes the additional steps of:

at the central computing means encoding a second telephone carrier with screen data and transmitting the encoded telephone carrier;

receiving the encoded second telephone carrier;

decoding the screen data from the encoded second telephone carrier;

selecting between the screen data decoded from the second telephone carrier, the screen data decoded from the selected band carrier, and stored screen data, for generating the display signal;

enabling the viewer to instruct the later recordal of desired screen data;

recording the moment by moment response of the viewer to a set of screens; and

providing a visual indication both of the presence of stored screen data and the viewers moment by moment response.

54. A method as claimed in claim 38 or 40, which includes connecting the display signal to a relay switch means which also receives a conventional television signal, connecting a television as the viewing apparatus to an output of the relay switch means and activating the relay switch means to select either the display signal or the conventional television signal for display on the television.

55. A method of remotely displaying screen data as screens on a viewing apparatus and recording responses from a viewer, the method comprising:

encoding and transmitting screen data on a

carrier;

receiving and decoding the screen data from the carrier;

producing from the screen data a display signal representing the screens to be displayed;

viewing the screens on a viewing apparatus;

accepting responses from the viewer and converting the responses into response data;

encoding a response carrier with the response data;

sending the encoded response carrier to a central computing means;

receiving the encoded response carrier;

decoding the response data from the encoded response carrier; and

at the viewing apparatus storing both received screen data and response data for transmission, whereby viewing of the screens and transmissions of the response data can be delayed.

AMENDED CLAIMS
[received by the International Bureau on 30 October 1989 (30.10.89); original claims 1,4,37-39 amended, all other claims unchanged (4 pages)]

1. A system for remotely displaying screen data as screens on viewing apparatus, the system comprising:

a plurality of commercial radio band carrier transmitters, each of the transmitters encoding and transmitting screen data on differing commercial radio band carriers; and

a plurality of devices each being for use with a corresponding viewing apparatus and comprising a band receiver adapted to receive an encoded band carrier and including a band tuner for tuning the band receiver to a selected band carrier, a band carrier decoder connected to the band receiver, the band carrier decoder being adapted to decode the screen data from the received band carrier, and a display signal means connected to the band carrier decoder, the display signal means being adapted to produce from the screen data a display signal representing the screens to be displayed and data storage means connected to the band carrier decoder for storing screen data from the band carrier decoder;

whereby each viewing apparatus when connected to the display signal means of a respective device accepts the display signal and displays the screens.

2. A system according to claim 1 further comprising, a central computing means connected to the band carrier transmitters, the central computing means being adapted to store and retrieve screen data and to route and transmit screen data to the band

carrier transmitters for transmission on the differing band carriers.

3. A system according to claim 2, further comprising, for each device a viewer control means coupled to the display signal means and capable of controlling when the display signal is produced.

4. A system according to claim 3 wherein the data storage means is also connected to the display signal means, and wherein the display signal means is additionally adapted to retrieve stored screen data from the storage means and the viewer control means is additionally coupled to the storage means for controlling selection of the source of screen data for the display signal means from the band carrier decoder and the storage means.

5. A system according to claim 4, wherein each device includes a processor unit connected to the respective band carrier decoder, display signal means, and storage means.

6. A system according to claim 3 or 4, wherein, for each device, the viewer control means is additionally coupled to the band tuner and is capable of controlling the band tuner to select a device band carrier.

7. A system according to claim 5, wherein, for each device, the viewer control means is additionally coupled to the band tuner and is capable of

display signal means, with the display signal means selecting either the decoder connected to the receiver or the telephone decoder as the source for the screen data.

36. A device as claimed in claim 15, which includes a relay switch means having one input for a conventional television signal and another input receiving the display signal from the display signal means, and an output for connection to a television, providing the viewing apparatus, the relay switch means being controllable by the viewer control means, to select either the conventional television signal or the display signal for display on the television.

37. A method for remotely displaying screen data as screens on a viewing apparatus, the method comprising:

encoding and transmitting screen data on differing commercial radio band carriers;

tuning and receiving a selected band carrier;

decoding the screen data from the selected band carrier;

storing the screen data decoded from the selected band carrier; and

producing from the screen data a display signal representing the screens to be displayed;

whereby the screens may be displayed on the viewing apparatus when the viewing apparatus accepts the display signal.

38. A method as claimed in claim 37 further comprising selecting as a source for the display signal one of the stored screen data and the screen data being received.

39. A method as claimed in claim 37 which includes the additional steps of:

accepting responses from a viewer of the viewing apparatus and converting the responses into response data;

encoding the response data onto a suitable response carrier;

transmitting the encoded response carrier;

receiving the encoded response carrier;

decoding the response data from the response carrier.

40. A method as claimed in claim 38 with the additional steps of:

accepting responses from a viewer of the display signal on a viewing apparatus, and converting the responses into response data;

encoding a first telephone carrier with the response data;

sending the encoded first telephone carrier;

receiving the encoded first telephone carrier;

decoding the response data from the first telephone carrier.

41. A method as claimed in claim 38, which includes the additional steps of:

encoding a second telephone carrier with screen data and transmitting the encoded second telephone carrier;

receiving the encoded second telephone carrier;

decoding the screen data from the encoded second telephone carrier; and

STATEMENT UNDER ARTICLE 19

Independent claims 1 and 37 were considered not novel or not involving an inventive step in view of U.S. Patent 4,745,468.

Because claim 1 has been amended to incorporate matter from claim 4 to more particularly point out that aspect of applicant's invention as being a data storage means connected to the band carrier decoder for storing screen data from the band carrier decoder, and because claim 37 has been amended to incorporate matter from claim 38 to recite that aspect of applicant's invention in a method format as storing the screen data decoded from the selected band carrier, claims 1 and 37 are believed to be allowable. Applicant respectfully, but vigorously, wishes to traverse the rejection of claims 1 and 37 as being anticipated by the '468 patent (Von Kohorn). Von Kohorn does not teach (nor suggest) the use of commercial radio band carriers to transmit encoded instruction signals to a remote television receiver facility to cause displays to appear on the screen of a television for viewing by a person who must respond to questions posed (emphasis added). The encoded instruction signals of Von Kohorn do not cause displays to appear on the screen of a television. Rather, these instructions are directed to a response unit 22 (see column 4, lines 1-8). The response unit 22 is independent of television screen 20 (see column 4, lines 29-32). Von Kohorn merely uses screen 20 to receive and display televised program material (see column 4, lines 26-29).

These amendments are believed to fully respond to the rejection of claims 1 and 37.

Since claim 39 has been amended to eliminate multiple dependency, claim 43 is now in proper form as not dependent from any other multiple dependent claim and is believed to be patentable as being dependent upon claims indicated as being allowable.

Nakagawa 4,584,602 has been reviewed; claims 1 and 37 presently pending (as amended) are believed allowable thereover.

For the reasons stated, all of the claims presently pending in this application are believed to be allowable.

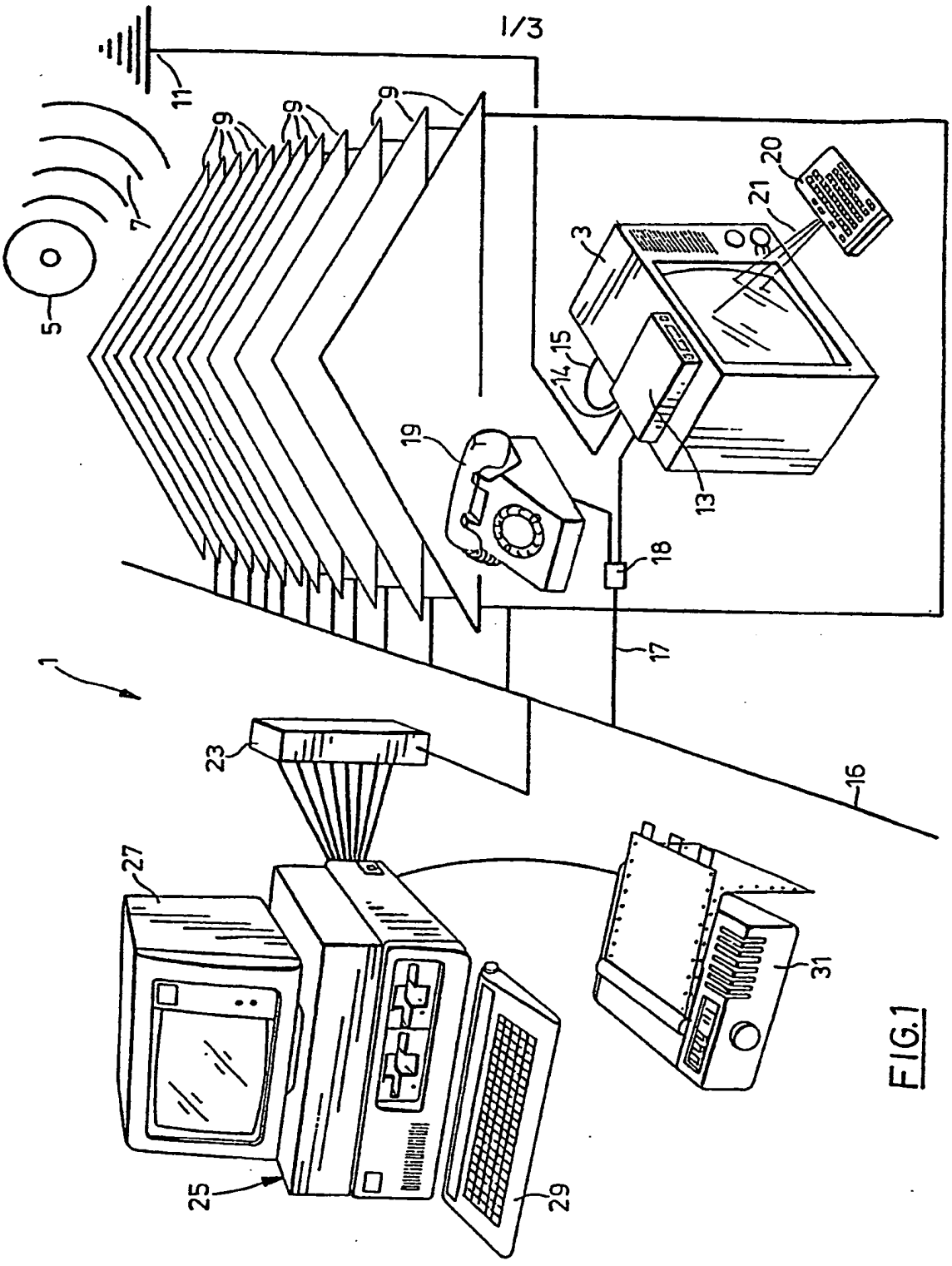

FIG.1

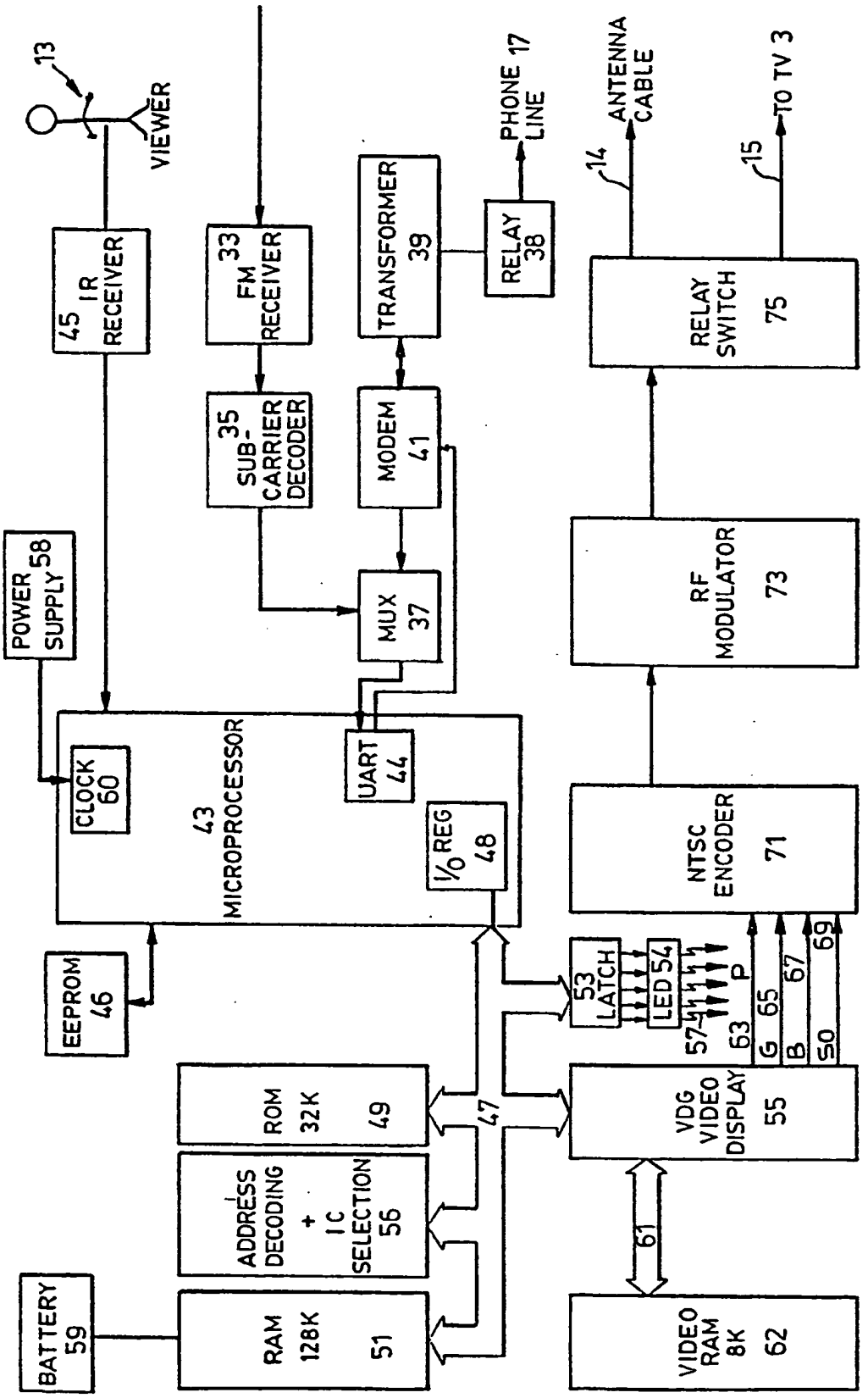
13
VIEWER
45 IR RECEIVER
33 FM RECEIVER
35 SUB-CARRIER DECODER
TRANSFORMER 39
RELAY 38
PHONE 17 LINE
14 ANTENNA CABLE
15 TO TV 3
RELAY SWITCH 75
MODEM 41
MUX 37
POWER SUPPLY 58
RF MODULATOR 73
CLOCK 60
43 MICROPROCESSOR
UART 44
1/0 REG 48
NTSC ENCODER 71
EEPROM 46
53 LATCH
LED 54
57 63 P G 65 B 67 S0 69
ROM 32K 49
47
VDG VIDEO DISPLAY 55
ADDRESS DECODING + IC SELECTION 56
61
BATTERY 59
RAM 128K 51
VIDEO RAM 8K 62

FIG.2

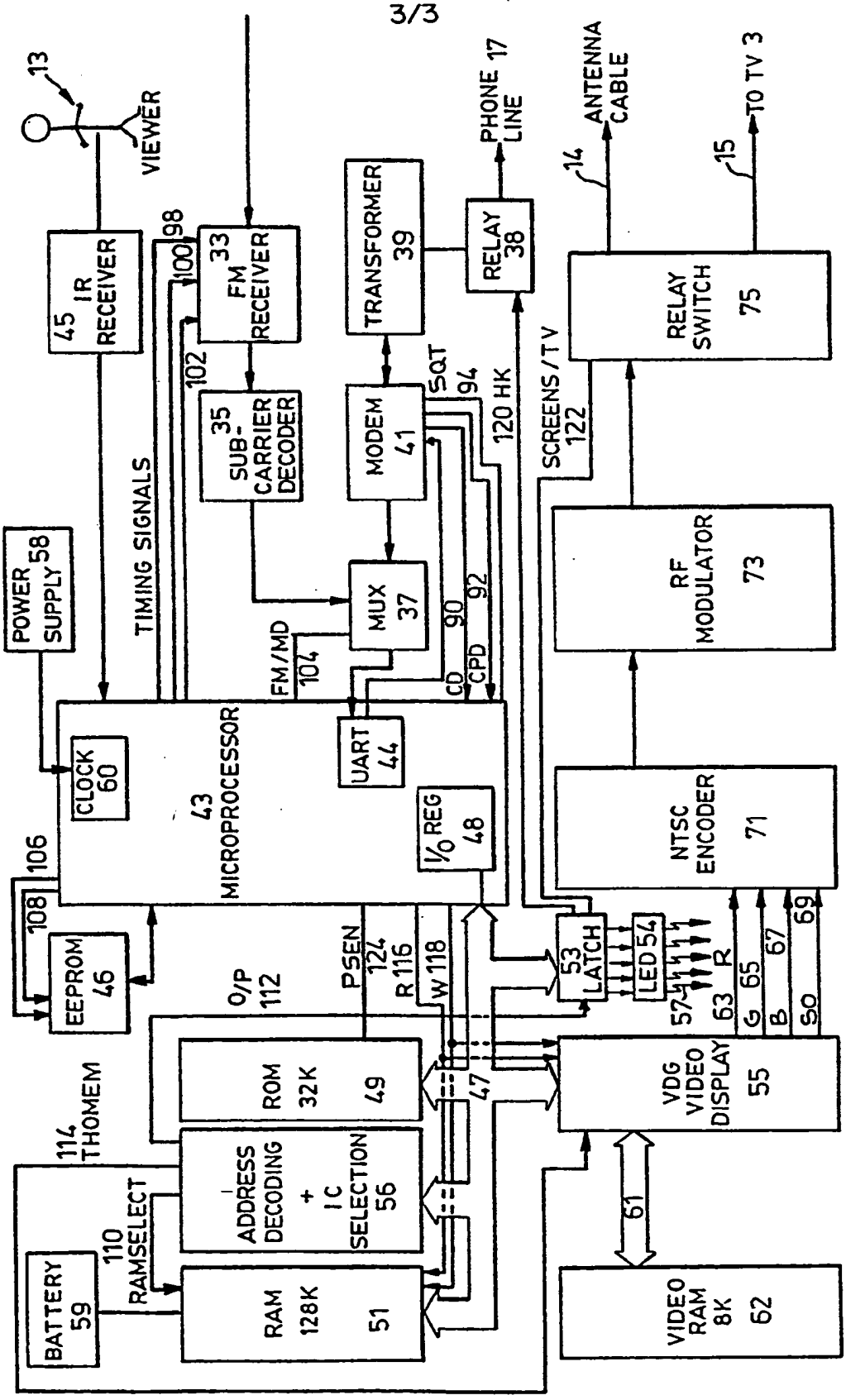
13
VIEWER
45 IR RECEIVER
98
100
33 FM RECEIVER
102
35 SUB-CARRIER DECODER
TIMING SIGNALS
POWER SUPPLY 58
CLOCK 60
106
108
EEPROM 46
43 MICROPROCESSOR
FM/MD 104
MUX 37
UART 44
1/0 REG 48
CD 90
CPD 92
SQT 94
120 HK
MODEM 41
TRANSFORMER 39
RELAY 38
PHONE 17 LINE
ANTENNA CABLE 14
TO TV 3 15
RELAY SWITCH 75
SCREENS/TV 122
RF MODULATOR 73
NTSC ENCODER 71
53 LATCH
LED 54
57
63
R 65
G 67
B 69
SO
PSEN 124
R 116
W 118
O/P 112
ROM 32K 49
47
VDG VIDEO DISPLAY 55
61
VIDEO RAM 8K 62
114 THOMEM
ADDRESS DECODING + IC SELECTION 56
110 RAMSELECT
RAM 128K 51
BATTERY 59

FIG.3

INTERNATIONAL SEARCH REPORT

International Application No. PCT/US89/00943

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [6]

According to International Patent Classification (IPC) or to both National Classification and IPC

IPC(4): H04M 11/00

US Cl. 379/92; 455/2; 358/84

II. FIELDS SEARCHED

Minimum Documentation Searched [7]

Classification System	Classification Symbols

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [8]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [9]

Category *	Citation of Document, [11] with indication, where appropriate, of the relevant passages [12]	Relevant to Claim No. [13]
X	US, A, 4,745,468 (KOHORN) 17 May 1988 See Abstract, Fig. 3, Col. 2, lines 1-68, Col. 3, lines 1-30 and 56-68, Col. 4, lines 1-32.	1 and 37
A	US, A, 4,584,602 (NAKAGAWA) 22 April 1986	

* Special categories of cited documents: [10]

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

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IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
16 May 1989	26 JUN 1989
International Searching Authority	**Signature of Authorized Officer**
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Form PCT/ISA/210 (second sheet) (Rev.11-87)

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

V. [X] OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE [1]

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. [ ] Claim numbers . because they relate to subject matter [2] not required to be searched by this Authority, namely:

2. [ ] Claim numbers . because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out [3], specifically:

3. [X] Claim numbers 43 , because they are dependent claims not drafted in accordance with the second and third sentences of PCT Rule 6.4(a).

VI. [ ] OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING [2]

This International Searching Authority found multiple inventions in this international application as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. [ ] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

[ ] The additional search fees were accompanied by applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

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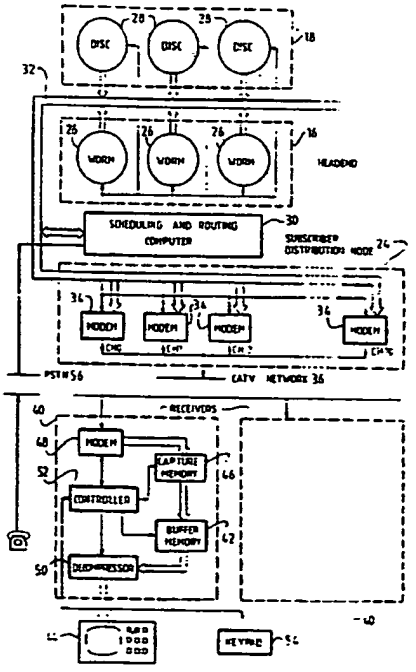
(54) Title: PROGRAM TRANSMISSION OPTIMISATION

(57) Abstract

A system and method of optimising transmission of a program to multiple users over a distribution system, with particular application to video-on-demand for a CATV network (36). The system includes, at a head end of the CATV network (36) a scheduling and routing computer (30) for dividing the video program stored in long term fast storage (16) or short term fast storage (18) into a plurality of program segments, and a subscriber distribution node (24) for transmitting the program segments in a redundant sequence in accordance with a scheduling algorithm. At a receiver (40) of the CATV network (36) there is provided a buffer memory (42) for storing the transmitted video program segments for subsequent playback whereby, in use, the scheduling algorithm can ensure that a user's receiver (40) will receive all of the program segments in a manner that will enable continuous playback in real time of the program. Under the control of controller (52) the receiver (40) distinguishes received program segments by a segment identifier so that redundant segments captured in capture memory (46) are then stored in buffer memory (42) from which the segments can be retrieved and decompressed in data decompressor (50) for immediate or subsequent viewing.



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PROGRAM TRANSMISSION OPTIMISATION

FIELD OF THE INVENTION

The present invention relates to a system and method for program transmission optimisation over a distribution system and relates particularly, though not exclusively, to such a method and system for supplying video-on-demand over a cable television network.

DISCUSSION OF THE PRIOR ART

Throughout the following specification the word "program" should be understood in the broadest sense of the term and includes any information, whether visual or audible, a mixture of both or otherwise, which is normally perceived in a substantially continuous sequence of impressions through one or more of the human senses. The term "video program" refers to a program of visual information or visual and audible information, whether recorded in reproducible format or transmitted "live". In our "information society", with its increasing emphasis on greater accessibility to information, there are many situations where the same program may be required to be accessed by more than one person at the same time.

Thus, for example, in a library of a large educational institution which stores lectures and other information on audio and/or video cassettes, the demand for certain programs may be particularly high at certain times and there is a need to be able to allow several students to listen to or view the program simultaneously from the beginning, without having to force individuals to start listening to or viewing the program at the same time. Ideally, it should be possible to service the needs of all persons requiring that program immediately when it is requested. In practice this is extremely difficult without expensive duplication of equipment and complex electronic processing. Another example of this type of multiple user situation is so called video-on-demand television. A video-on-demand system ideally allows any subscriber to request (demand) any particular video program at

any time of the day.

A prior art video-on-demand system is described in U.S. 4,506,387 to Walter in which each video program is pre-programmed in a memory device selectable by a host computer at a central data station in response to an address signal transmitted from the user. The host computer controls the transmission of the video program at a high non-real-time rate over a fibre optic line network to a data receiving station at the users location. The data receiving station then converts the received optical data to electrical data and stores it for subsequent real-time transmission to the users television set.

There are a number of significant disadvantages with the system of Walter, the foremost being that it is incompatible with existing television transmission networks, and in particular CATV coaxial cable networks. In order to achieve a rapid response time Walter transmits all of the digital data corresponding to an entire program to the receiving station over a plurality of fibre optic lines within a very short time. Even with compression of the digital data the bandwidth requirement for this system is relatively large. For example, sixteen (16) optical data channels over four fibre optic lines are required to transmit a two hour movie in about thirty one seconds. Very few homes or buildings currently have ready access to a fibre optic cable, and a fibre optic network is expensive to install.

A further disadvantage with the system of Walter is that it cannot adequately handle a high demand for the same video program. Research in video tape lending libraries indicates that out of a total of say five thousand tapes held in the library, at any one time only a core group of twenty to forty most popular titles are in high demand. Furthermore, this research into the viewing habits of viewers indicates that the core video demand requirement varies throughout the day as the nature of the viewers changes. Whilst Walter contemplates that the central data station may transmit only a portion of the selected program to the user for his viewing, and then begin transmitting a portion of another selected program to a second user, the system cannot simultaneously handle several

users requesting the same program. In that event, a user must wait until transmission of the entire program to each user who placed a request prior to his own has been completed, before the system can attend to his demand. Clearly with core video programs this could result in unacceptable delays.

SUMMARY OF THE INVENTION

The present invention was developed with a view to providing a method and system for program transmission optimisation over a distribution system for multiple users, and was developed specifically, though not exclusively, with a view to providing a system and method for supplying video-on-demand which is compatible with existing video distribution systems such as CATV. Throughout this specification the term "distribution system" is to be construed in the broadest sense of the term and covers ordinary radio and television networks, CATV and internal television/video/audio distribution systems of the kind employed in hotels, educational institutions and more recently in aircraft and ocean liners.

According to one aspect of the present invention there is provided a method for optimising transmission of a program to multiple users over a distribution system, the method comprising:

at a head end of the distribution system,

dividing the program into a plurality of program segments; and,

transmitting the program segments in a redundant sequence in accordance with a scheduling algorithm; and at a receiver of the distribution system,

storing the transmitted program segments in a buffer storage means in the receiver for subsequent playback whereby, in use, said scheduling algorithm can ensure that a user's receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program.

Preferably the method further comprises selecting a Maximum Response Time (MRT) corresponding to a maximum time a user need wait to commence playing a requested program.

Typically the step of dividing the program involves dividing the program into segments of a length selected such that at least one segment can be transmitted in the time of one MRT.

In the preferred embodiment said step of transmitting the segments involves transmitting one or more segments during each MRT, including a first segment corresponding to a first segment of playing time of the program, in accordance with the scheduling algorithm whereby, in use, the first segment is always available at a receiver within one MRT for immediate playback.

According to another aspect of the present invention there is provided a system for optimising transmission of a program to multiple users, the system comprising:

at a head end of the system:

means for dividing the program into a plurality of program segments; and,

means for transmitting the program segments in a redundant sequence in accordance with a scheduling algorithm;

and at a receiver of the system,

buffer storage means for storing the transmitted program segments for subsequent playback on the receiver whereby, in use, said scheduling algorithm can ensure that the receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program at the receiver.

Preferably the system further comprises at the head end of the system:

means for numbering the program segments 1 to n, where n equals the number of segments into which the program is divided, and wherein the segments are numbered in the order in which they should appear in the program for normal playback.

According to a further aspect of the present invention there is provided a receiver for receiving a program supplied by a program transmission optimisation system, the

receiver comprising:

buffer storage means for storing a plurality of program segments of the program transmitted from a head end of the system according to a scheduling algorithm; and,

processing means for processing said program segments stored in the buffer storage means and supplying the segments in the correct sequence for playback whereby, in use, said scheduling algorithm can ensure that the receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program at the receiver.

Typically said processing means comprises means for distinguishing received program segments by a segment identifier, wherein said segment identifier at least identifies a segment by its number whereby, in use, the receiver can distinguish redundant segments from segments required for subsequent playback.

According to a still further aspect of the present invention there is provided a scheduling apparatus for a program transmission optimisation system, the apparatus comprising:

means for dividing the program into a plurality of program segments;

means for scheduling said plurality of program segments in a redundant sequence in accordance with a scheduling algorithm; and,

means for routing said scheduled program segments for transmission to one or more receivers of users requesting the program whereby, in use, said scheduling algorithm can ensure that a user's receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program.

Preferably said means for dividing divides the program into segments of a length selected such that at least one segment can be transmitted in a Maximum Response Time (MRT) time interval, wherein MRT corresponds to a maximum time a user need wait to commence playing a requested program from its beginning.

The scheduling algorithm preferably employed in the invention involves iteratively calculating during each MRT the result of COUNT Modulo X= Y, wherein COUNT = a predetermined initial whole number incremented by 1 each MRT, X=1 to n, where n = the number of segments into which the program has been divided, whereby, in use, wherever Y=0 the program segment number X will be transmitted.

BRIEF DESCRIPTION OF DRAWINGS

In order to facilitate a better understanding of the nature of the invention a detailed description of one preferred embodiment of a program transmission optimisation system and method in the form of a video-on-demand system and method will now be given, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic diagram of a preferred embodiment of a video-on-demand system;

Figure 2 is a more detailed block diagram illustrating the functional blocks of the video-on-demand system in Figure 1 applied to a CATV network;

Figure 3 is a flow chart of the method steps employed at a head end of the video-on-demand system;

Figure 4 is a flow chart of the method steps employed at a receiver of the video-on-demand system;

Figure 5 is a tabular representation of the transmission sequence of video segments in accordance with a preferred scheduling algorithm; and,

Figure 6 is a graphical representation of the relationship between Maximum Response Time and the required video-hours/hour of transmission time.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Figure 1 illustrates schematically a preferred embodiment of the video-on-demand system according to the present invention. Referring to Figure 1, external non-compressed material can enter the system in its most basic format such as 35mm film, video tape, or through a telecommunications link such as broadcast television or

satellite transmission. The non-compressed material is passed through a media compression system 10 for compressing the audio visual program material into a compressed format. The audio visual program material may be compressed by an external video compression service provider, such as Intel Corporation. Such external compressed material may enter the system directly via a storage distribution node 12. The storage distribution node 12 routes the compressed video material to the appropriate storage medium.

There are three types of storage in the system, long term slow storage 14, long term fast storage 16 and short term fast storage 18. The division of the storage of compressed video material into the different types of storage is based on commercial considerations, in view of the relatively high cost of fast storage media compared to slow storage media. The selection of the type of storage to which different programs would be routed is based upon the expected future demand for the video material concerned. Daily news segments would probably be stored in short term fast storage 16, whereas a movie classic such as "Gone With The Wind" would probably be stored in long term fast storage 16. Infrequently requested materials such as some obscure silent movie would probably be stored in long term slow storage 14. The storage distribution node 12 is typically a micro or mini computer which controls the flow of data between the different storage devices.

The long term slow storage 14 typically takes the form of storage media such as magnetic tapes, or optical discs and may require human intervention for retrieval of infrequently accessed program material. The long term fast storage 16 may typically take the form of a jukebox type of optical disc storage device. Optical disc storage provides high density storage with random access, and the jukebox access mechanism provides automatic program access. A typical unit currently available is the KODAK Optical Disc System 6800 drive/cabinet. The short term fast storage 18 may take the form of a magnetic disc drive such as an IBM Model 3380. This allows rapid random access to the compressed video material stored in digital format, but is a relatively expensive storage

medium and would therefore only be used for storing popular core video programs.

The scheduling and routing computer 20 receives requests for specific audio visual material from user's receivers 22A, 22B or 22C via a bi-directional request and distribution network. The scheduling and routing computer 20 controls the retrieval and division of the selected video program in a plurality of video segments, schedules the video segments in accordance with a scheduling algorithm and controls the routing of the scheduled segments for transmission to one or more of the receivers 22A, 22B or 22C, so that each requesting viewer's receiver will receive all of the video segments in a manner that will enable continuous immediate viewing of the program. The video-on-demand system employs a combination of frequency multiplexing and time division multiplexing. The time division multiplexing of the video segments is controlled by the scheduling and routing computer 20 in accordance with the scheduling algorithm. The frequency multiplexing is performed by a subscriber distribution node 24 under the control of the scheduling and routing computer 20. The processing capabilities of the scheduling and routing computer 20 are similar to that required by computers used by banks for automatic teller machines. The scheduling and routing computer 20 may be any suitable computer with a typical processing capability of 1.5 to 200 million instructions per second (MIPS), depending on the size of the subscriber base and other loading factors.

The viewer's receivers 22 are typically frequency agile, to be compatible with the frequency multiplexing employed at the head end of the system. The receivers are provided with processing means to capture the appropriate data packets created by the time division multiplexing of the video segments. The receivers 22 are also provided with buffer storage means for storing the received video segments, and would typically also comprise decompression means for decompressing the video data for subsequent display on a dedicated television screen, or fed into a conventional television set.

The video-on-demand system of Figure 1 can operate on either analog or digital communication circuits, however in the preferred embodiment described below the video distribution system is a conventional cable television system which is analog. In the preferred embodiment of the system described below primarily modulated digital data is transmitted over the CATV network. However, it is envisaged that a future system will employ a mixture of analog and modulated digital signals.

The method of program transmission optimisation according to the invention can provide transmission optimisation for either digital or analog information signals.

Conventional CATV systems are typically simplex communication systems (one way only) so that there is no easy way to retransmit data when errors are detected. Accordingly, some form of error compensation is required. Fortunately, television data is generally used in a very transient manner, unlike computer data that must be assured of accurate transmission. If a few frames of a TV image are disturbed most viewers accept this without even a conscious acknowledgment of their occurrence. Accordingly, a much higher bit error rate can be tolerated, for example 1 erroneous data bit per 100,000. At this rate the human eye/brain system normally cannot even detect the video effects caused by this erroneous bit. Most digital modems work with bit error rates of 1 in 100,000,000 to 1 in 1,000,000,000! Therefore, the video-on-demand system can tolerate error rates typically from 1,000 to 10,000 times higher than most computer data systems are presently designed for. A higher error rate will of course improve performance, although the improvement may be imperceptible to a viewer.

Figure 2 illustrates in block diagram form a preferred embodiment of the video-on-demand system applied to a CATV network. The video demand system comprises at the head end means for providing a video program in a compressed format in the form of Write Once Read Many (WORM) storage devices and magnetic disc storage devices 28 providing long term fast storage 16 and short term fast storage 18 respectively. In this particular embodiment the compressed video material is stored in digital format in the storage devices and the video

programs may already be segmented in the storage media in video packets sized to be compatible with the system specifications. The magnetic disc devices 28 and WORM devices 26 are connected to a scheduling and routing computer 30 by data bus 32.

The scheduling and routing computer 30 responds to a subscriber request for a particular program by retrieving the video program from the appropriate storage media and dividing the video program into a plurality of video segments. As mentioned above, the video program may be stored in the storage media already in segments corresponding to the scheduling requirements of the system thereby reducing the load on the computer 30 during the process of retrieving and dividing the video program into video segments. The computer 30 then schedules the plurality of video segments of the video program in accordance with a scheduling algorithm, as will be described in more detail below, and routes the scheduled video segments for transmission to one or more receivers of viewers requesting the video program. For core video programs (those that are in continuous demand by at least one subscriber for periods of more than one Video Playing Time (VPT)), the scheduling algorithm can be run once and the packets stored in the scheduled sequence on a serial recording device such as a tape drive (not shown), to further reduce loading on the computer.

In this embodiment the subscriber distribution node 24 comprises a plurality of modems 34 under the control of the scheduling and routing computer 30. Each modem 34 modulates a different carrier frequency signal, corresponding to each of the channels on the CATV network 36, for transmitting the video segment data packets routed to the appropriate modem 34 by the scheduling and routing computer 30 over data bus 32.

Each subscriber on the CATV network 36 is provided with a receiver 40 for receiving the video segment data packets corresponding to the requested program and storing the video segments for future viewing by the subscriber. Each receiver 40 typically comprises a buffer memory 42 for storing the video segments of the video program transmitted from the head end, and video processing means for processing the video segments stored in the buffer memory and supplying the segments in the

correct sequence to a subscriber television set 44 for viewing. Typically the video processing means may include a controller 52 and a capture memory 46 for capturing the video segment data packets received over the CATV network 36 and demodulated by one or more modems 48 of the receiver. Under the control of controller 52 the video processing means distinguishes received program segments by a segment identifier, for example the PKT ID, so that redundant segments can be ignored and overwritten in capture memory 46. Modem 48 is preferably a frequency agile broad band modem such as the Fairchild M505, although as noted above a more low level digital modem with lower bit error rate can also be employed. Compressed video data packets captured in capture memory 46 are stored in buffer memory 42 from which the segments can be retreived and decompressed in data decompressor 50 for immediate or subsequent viewing. The microprocessor based controller 52 controls the flow of data and the video processing within the receiver 40.

Some CATV systems can accommodate bidirectional decoders or receivers, and for this type of system the receiver 40 is provided with a key pad 54 to enable the subscriber to initiate a request via the CATV network 36. However, the majority of CATV systems are unidirectional (simplex) and a subscriber request must therefore be made over the public switched telephone network (PSTN) 56. The subscriber request via the PSTN 56 may be verbal or via touch tone keying similar to that provided by other on-line subscriber network service providers.

Security on the system to prevent unauthorised viewing of transmitted programs may be implemented in several ways. Standard encryption algorithms could be applied at the modems 34 prior to transmission. Each receiver 40 would then require a key to decrypt the received data. Encryption/ decryption keys are distributed to subscribers in a similar manner to that employed by financial institutions to distribute PINs for automatic teller machine usage. Alternatively, each data packet transmitted at the head end can be prefixed with a receiver ID unique to each subscriber so that a pirate receiver would need to select the appropriate receiver ID in

order to receive a particular video program.

It will be appreciated that the video-on-demand system illustrated in Figure 2 is exemplary only, and that many other hardware implementations could be employed to effect the method and system for supplying video-on-demand according to the invention. For example, the receivers 40 may comprise several modems for simultaneously receiving data packets over several channels, and the capture memory may be dispensed with if the video segments are stored in the buffer memory in compressed format. The video segments are then decompressed when they are provided to the subscriber's television set in the correct sequence for viewing. Furthermore, certain sections of the head end apparatus or of the receiver may be located at different geographical locations. For example, in view of the typical architecture of CATV systems, it is possible that the modem and buffer sections of the receiver will become part of the cable network in what is referred to as a subscriber tap, and that the other sections would be located at the subscriber's premises.

It should be noted that the video segment data packets for a particular program need not be transmitted over the same channel for all viewing subscribers. By employing a combination of time division multiplexing and multiple channels at the head end of the system, data rates over each of the channels can be kept at a minimum therefore allowing the use of less expensive hardware at the receivers. Each receiver 40 may be configured to scan the channels in a cyclic fashion in order to determine which channel or channels the appropriate video segments are being transmitted. In addition to this a dedicated control channel can be provided over which data from the scheduling and routing computer 30 is transmitted to instruct each receiver as to which packets to receive and on which channel(s). However, preferably the head end transmits the video segments in accordance with the scheduling algorithm in a continuous manner, with each video segment provided with a title ID as well as a segment ID, so that each receiver will receive all of the video segments with the appropriate title ID and can discard or overwrite the video segments already

received.

A key feature of the present invention is the scheduling of the video segments for transmission in a redundant sequence in a manner that will ensure that each receiver will receive all of the video segments for the requested program according to a schedule that will enable continuous playback in real time of the video program at the receiver. A preferred form of an efficient scheduling algorithm and its implementation will now be described in detail.

In the following description the term "Maximum Response Time" (MRT) refers to the maximum time a subscriber will need to wait before the video program requested will be available for viewing at his receiver. MRT refers to the maximum time that the system has to respond to the demand. Video Play Time (VPT) refers to the time required to play the particular video program when viewed at normal play back speed. The data that comprises the video program must be divided into video segment data packets of such a length that one packet can be transmitted in the time of 1 MRT. The video segment play back time or slot length of one data packet need not be less than 1 MRT and may be longer than 1 MRT depending on how much band width is available over the transmission medium for transmitting the data packet(s) in the time of 1 MRT. The slot length may be variable in order to adjust the instantaneous loading and data rates on the transmission medium or to adjust the amount of buffer storage space required in the receivers. However, in any one installation, the slot length and MRT would normally be fixed for a specific system configuration. In the following description the slot length has been made equal to the MRT in order to simplify explanation. Thus, for example, if the video program is 60 minutes long and the MRT is 5 minutes, the video program is divided into 12 discreet data packets each corresponding to 5 minutes of video segment data. Each of the data packets is numbered from 1 to n where n equals VPT/MRT, in chronological viewing order.

Implementation of the scheduling algorithm is preferably under software controlled by the scheduling and

routing computer 30. The basic flow of the scheduling program is as follows:

```
          set MRT equal to chosen maximum response time
          set a counter equal to 0 an initial value
          retrieve video segment data packets sized to relate
          to a play time of MRT (PKT1, PKT2 ....PKTn).
loop      wait for remainder of period equal to MRT
          set COUNT equal to COUNT plus 1
          if (COUNT Modulo 1) = 0 then transmit PKT1
          if (COUNT Modulo 2) = 0 then transmit PKT2
          if (COUNT Modulo 3) = 0 then transmit PKT3
          .....
          .....
          .....
          if (COUNT Modulo n) = 0 then transmit PKTn
          start again at loop
```

Note: (x Modulo y) = the remainder of (x divided by y).

In accordance with the above scheduling algorithm video segment data packets are transmitted in a redundant sequence, with one or more data packets being transmitted during each MRT. Each transmission starts at an incremental time n*MRT, and in many instances a majority of the MRT period is expended in actually accomplishing the transmissions. With the above scheduling algorithm PKT1 will always be transmitted, however the other packets may or may not be transmitted at any given value for COUNT. Hence, any particular requesting receiver may receive the packets in a non-contiguous stream. Thus, for an MRT = 5 and a VPT = 60 it may receive the packets as follows:

MRT	PKTs Received	PKTs Viewed
1	PKT1 AND PKT3	PKT1 VIEWED
2	PKT2	PKT2 VIEWED
3	PKT4 AND PKT8 AND PKT12	PKT3 VIEWED
4	NO PACKETS	PKT4 VIEWED
5	PKT5 AND PKT6 AND PKT7 AND PKT11	PKT5 VIEWED
6	NO PACKETS	PKT6 VIEWED
7	NO PACKETS	PKT7 VIEWED
8	PKT9 AND PKT10	PKT8 VIEWED

9	PKT9 VIEWED
10	PKT10 VIEWED
11	PKT11 VIEWED
12	PKT12 VIEWED

The above sequence is just one of many possible packet delivery sequences produced by the algorithm. Figure 6 is a graphical representation of the sequence of video segment data packets transmitted during each MRT time interval. The number of each video segment appears on the vertical axis and the number of the MRT interval appears along the horizontal axis. Figure 6 shows a maximum of 30 video segments and 49 MRT intervals, however obviously these are arbitrary numbers and both axes could be continued indefinitely. There would be a practical limit to the number of video segments that the video program could be divided into, however the number of MRT intervals will be a function of the duration for which a particular program is in continuous demand. From casual observance of the sequence output of the algorithm it would appear to be a random ordering of packets. However, although the sequence may be considered pseudo-random, it is in fact non-random in that it ensures that a receiver never has to wait on any packet to be transmitted and can provide immediate viewing of the video segments in the correct sequence. Accordingly, by the time the receiver is ready to display a particular packet, that packet will either be in the buffer memory, or being received at that time.

In the above table, redundant packets have not been included in the "PKTs received" column since in practice these would be discarded or overwritten by the receiver. In the above sequence example it will be noted that within a time equal to 8 MRTs all 12 packets have been received, and that certain packets, for example PKT12, is received by the receiver well before it is needed for viewing. PKT12 and any other packets received early are held in the buffer until the appropriate time for viewing. The scheduling algorithm ensures that a packet is always received when it is due to be viewed or before.

In Figure 6, it can be seen that at certain times, for example, MRT intervals 12, 24 and 36 a larger number of packets are received than at other times, which tends to increase the load on the transmission medium and the buffer memory in the receivers. It is preferable that the buffer memory be large enough to store all of the data packets for a particular program, and this also enables the receiver to store the program for later viewing if desired.

The underlying design considerations for the scheduling algorithm and the amount of buffer memory required in the receivers involve trade off's between the response time (MRT) guaranteed to viewers, the bandwidth required for servicing requests, and the amount of buffer storage space provided in the receivers. The principle advantage of a scheduling algorithm of the above kind is the efficient utilisation of the transmitting medium that can be realised. Thus, for example, if an MRT of 5 minutes is required, without the scheduling algorithm the complete video program would need to be transmitted continuously from the beginning every 5 minutes. Thus, for a program with 60 minutes play time the complete program would have to be transmitted 12 times. Using the above scheduling algorithm the number of data packets required to be transmitted to provide an MRT of 5 minutes is equal to having to transmit the entire program only 3.12 times.

The relationship between MRT and the total amount of data that must be transmitted can be represented by the following "best fit curve" equation:

$$\text{TOTAL DATA} = \frac{\text{LOG (MRT/154.94)}}{-\ 0.47782}$$

Total data is in terms of VPT, so that a data amount of 3 is equal to 3 times the VPT or 180 minutes worth of data for a 60 minute program supplied with an MRT of 5 minutes. Figure 6 is a graphical representation of the relationship between MRT and the required video-hours/hour of transmission time or the total amount of data transmitted.

It will be appreciated that although the above described scheduling algorithm is the preferred form, modifications can be made to the algorithm that would allow

trade off's between transmission efficiency and the amount of buffer storage required. Commercial considerations will determine how the balance of system costs are weighted. If more is spent on receiver buffers, then less will be required to be spent on provision of transmission lines.

In an example of a modified scheduling algorithm it is possible to diverge from the requirement of always sending PKT1. In this case, PKT1 and other selected packets may be transmitted less frequently and held in available buffer storage space at the receivers until a request is lodged. For example, the following implementation can be adopted:

Each receiver is provided with low power buffer memory devices which are kept active at all times for receiving selected packets of video programs. Assuming there are, say, 10 core video programs, the receivers can be configured to store PKT1 of each of the 10 core video programs, PKT1 being only transmitted at predetermined intervals in accordance with the modified scheduling algorithm, rather than at each MRT as in the above described scheduling algorithm. Hence, when a request for a core program is lodged, the first packet is already in the receiver buffer memory and can be immediately accessed for viewing while the modified scheduling algorithm is then implemented. This can reduce transmission bandwidth requirements considerably, with a modest increase in receiver cost, while providing instantaneous delivery of the core program to the viewer.

It is also possible to reduce peak transmission loads by diverging from the requirement that all requests start to be serviced within a maximum period equal to MRT. By accepting a small percentage of service delays, it is possible to further smooth the transmission load.

A typical software control sequence at both the head end computer and at the receiver will now be described with reference to Figures 3 and 4. When the head end scheduling and routing computer receives a subscriber request it records the subscriber ID, the requested program title ID and the time of request. The computer tracks each request and its progress towards completion in accordance with the scheduling algorithm.

There will normally be several program streams being transmitted at any one time. The scheduling algorithm generates different data rates at different times as noted above. By staggering the entry value of COUNT for different program streams, the total data rate on the transmission medium can be maintained at a fairly constant level. Depending upon the value of COUNT at which a particular request enters the algorithm, the time taken to complete transmission of a requested program may range from 1 MRT to 1 VPT or any value in between.

Hence, when the head end computer has recorded the subscriber ID, title ID and time of request it determines whether the requested program is currently active, and if so enters the scheduling sequence at the conclusion of the current MRT time interval. If the requested program is not currently active then the COUNT value of the computer's internal counter, (may be a software counter) is set to the appropriate initial value to provide a staggering of the entry value of COUNT for each different program stream. Thus, for example, assuming requests are made simultaneously for programs A, B, C and D, service of the four requests can all commence simultaneously. However, program A would enter the algorithm scheduling sequence with COUNT equal to zero, B with COUNT equal to 1, C with COUNT equal to 2 and D with COUNT equal to 3. Thus, during each MRT time interval different numbers of video segments for each of the programs would be transmitted simultaneously, rather than the same number of video segments for each respective program.

At the commencement of the next MRT interval the computer enters the scheduling algorithm program sequence noted above and schedules the data packets for the title requested as per the scheduling algorithm. The computer also appends the title ID and packet ID to each data packet. The computer then selects a free channel and routes the data packets to the corresponding modem for transmission to the requesting receivers. The head end computer follows this sequence of steps until all of the packets for the requested title have been transmitted since the time of the last request for this

title. As soon as the computer has determined that all pending requests have been satisfied, no further data packets for that program are transmitted.

At the receiver, after the subscriber has sent a request the receiver scans the transmission channels and looks for the title ID. When the receiver finds the title ID it looks for the packet ID and stores any packets not already received in the buffer storage. If a packet has already been received this packet is discarded and the receiver continues to look for the remaining data packets until all the data packets for the video program have been received. Data packets stored in the buffer storage may be sent to the receiver directly for immediate viewing or stored for later viewing. Although not illustrated in Figure 4, the receiver may also be configured to look for its unique address ID to provide a degree of security against unauthorised data reception.

From the above description of a preferred embodiment of the program transmission optimisation comprising a system and method of supplying video-on-demand it will be apparent that the scheduling algorithm employed provides an efficient means of transmitting a program to multiple requesting subscribers who can commence playback of the program within a specified maximum response time. It will be apparent to those skilled in the electronics, television and telecommunication arts that numerous modifications and alterations may be made to the program transmission optimisation system and method, other than those already described, without departing from the basic inventive concepts. For example, in alternative realisations of the system and method an optical fibre network may be employed for the distribution system, for example, to provide programming on demand for aircraft passengers. Furthermore, the system and method can operate using analog communications as well as digital, or a mixture of both. Although in the video-on-demand system described the video program segments are transmitted in compressed format, this is obviously not an essential feature of the invention, since significant improvements in transmission efficiency can be achieved by relying upon the scheduling algorithm alone. All

such modifications and alterations are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description and the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for optimising transmission of a program to multiple users over a distribution system, the method comprising:

at a head end of the distribution system,

dividing the program into a plurality of program segments; and,

transmitting the program segments in a redundant sequence in accordance with a scheduling algorithm;

and at a receiver of the distribution system,

storing the transmitted program segments in a buffer storage means in the receiver for subsequent playback whereby, in use, said scheduling algorithm can ensure that a user's receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program.

2. A method as claimed in claim 1, further comprising the step of selecting a Maximum Response Time (MRT) corresponding to a maximum time a user need wait to commence playing a requested program from its beginning.

3. A method as claimed in claim 2, wherein said step of dividing the program involves dividing the program into segments of a length selected such that at least one segment can be transmitted in the time of one MRT.

4. A method as claimed in claim 3, wherein said step of transmitting involves transmitting one or more segments during each MRT, including a first segment corresponding to a first segment of playing time of the program, in accordance with the scheduling algorithm whereby, in use, the first segment is always available at a receiver within one MRT for immediate viewing.

5. A method as claimed in claim 4, further comprising at the head end of the distribution system the step of

numbering the program segments 1 to n, where n equals the number of segments into which the program is divided, and wherein the segments are numbered in the order in which they should appear in the program for normal playback.

6. A method as claimed in claim 5, wherein the scheduling algorithm involves iteratively calculating during each MRT the result of:

COUNT Modulo X = Y,

wherein COUNT = a predetermined initial whole number incremented by 1 after each MRT;

X = 1 to n, where n = the number of segments into which the program has been divided;

whereby, in use, whenever Y=0, the program segment number X will be transmitted.

7. A method as claimed in claim 1, further comprising the steps of recording a user identification number, a program title identification number and a time of each request in a subscriber request map; and, tracking each request and its progress towards completion.

8. A system for optimising transmission of a program to multiple users, the system comprising:

at a head end of the system:

means for dividing the program into a plurality of program segments; and,

means for transmitting the program segments in a redundant sequence in accordance with a scheduling algorithm;

and at a receiver of the system,

buffer storage means for storing the transmitted program segments for subsequent playback on the receiver whereby, in use, said scheduling algorithm can ensure that the receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program at the receiver.

9. A system as claimed in claim 8, further comprising at the head end of the system:

means for numbering the program segments 1 to n, where n equals the number of segments into which the program is divided, and wherein the segments are numbered in the order in which they should appear in the program for normal playback.

10. A system as claimed in claim 9, further comprising at the head end of the system:

means for appending a segment identifier to each program segment prior to transmitting, wherein said segment identifier at least identifies a program segment by its number.

11. A system as claimed in claim 8 or 9, wherein said means for transmitting transmits one or more of said program segments during each Maximum Response Time (MRT) time interval, wherein MRT corresponds to a maximum time a user need wait to commence playing a requested program.

12. A system as claimed in claim 11, further comprising at the head end of the system:

means for iteratively calculating during each MRT the result of the scheduling algorithm:

COUNT Modulo X = Y,

wherein COUNT = a predetermined initial whole number incremented by 1 after each MRT;

X = 1 to n, where n = the number of segments into which the program has been divided;

whereby, in use, whenever Y=0, the program segment number X will be transmitted.

13. A receiver for receiving a program supplied by a program transmission optimisation system, the receiver comprising:

buffer storage means for storing a plurality of program segments of the program transmitted from a head end of the system according to a scheduling algorithm; and,

processing means for processing said program segments

stored in the buffer storage means and supplying the segments in the correct sequence for playback whereby, in use, said scheduling algorithm can ensure that the receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program at the receiver.

14. A receiver as claimed in claim 13, where said processing means comprises means for distinguishing received program segments by a segment identifier, wherein said segment identifier at least identifies a segment by its number whereby, in use, the receiver can distinguish redundant segments from segments required for subsequent playback.

15. A receiver as claimed in claim 13 or 14, wherein said processing means further comprises decompressing means for decompressing compressed program segments transmitted from the head end of the program transmission optimisation system.

16. A scheduling apparatus for a program transmission optimisation system, the apparatus comprising:

means for dividing the program into a plurality of program segments;

means for scheduling said plurality of program segments in a redundant sequence in accordance with a scheduling algorithm; and,

means for routing said scheduled program segments for transmission to one or more receivers of users requesting the program whereby, in use, said scheduling algorithm can ensure that a user's receiver will receive all of the program segments in a manner that will enable continuous playback in real time of the program.

17. A scheduling apparatus as claimed in claim 16, wherein said means for dividing divides the program into segments of a length selected such that at least one segment can be transmitted in a Maximum Response Time (MRT) time interval, wherein MRT corresponds to a maximum time a user need

wait to commence playing a requested program from its beginning.

18. A scheduling apparatus claimed in claim 17, further comprising means for numbering the program segments 1 to n, where n equals the number of segments into which the program is divided, and wherein the segments are numbered in the order in which they should appear in the program for normal playback.

19. A scheduling apparatus as claimed in claim 18, further comprising means for iteratively calculating during each MRT the result of the scheduling algorithm:

COUNT Modulo X = Y,

wherein COUNT = a predetermined initial whole number incremented by 1 after each MRT;

X = 1 to n, where n = the number of segments into which the program has been divided;

whereby, in use, whenever Y=0, the program segment number X will be transmitted.

20. An apparatus as claimed in claim 16, wherein said means for dividing retrieves the program segments from a compressed program storage means wherein the program is stored in segmented format corresponding to said plurality of segments.

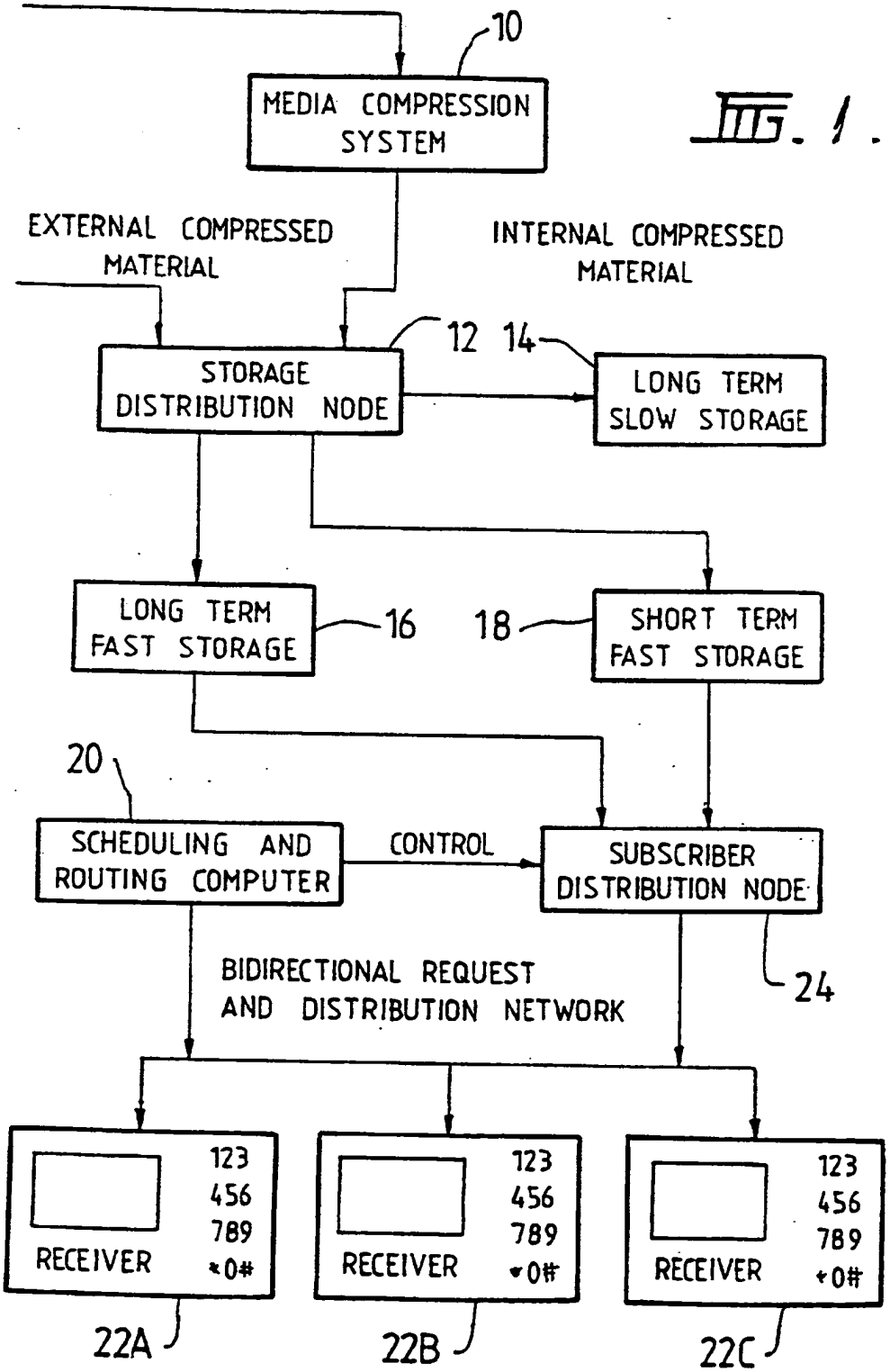
EXTERNAL NON-COMPRESSED MATERIAL
10
MEDIA COMPRESSION SYSTEM
EXTERNAL COMPRESSED MATERIAL
INTERNAL COMPRESSED MATERIAL
12
14
STORAGE DISTRIBUTION NODE
LONG TERM SLOW STORAGE
LONG TERM FAST STORAGE
16
18
SHORT TERM FAST STORAGE
20
SCHEDULING AND ROUTING COMPUTER
CONTROL
SUBSCRIBER DISTRIBUTION NODE
24
BIDIRECTIONAL REQUEST AND DISTRIBUTION NETWORK
123
456
789
*0#
RECEIVER
22A
22B
22C

FIG. 1.

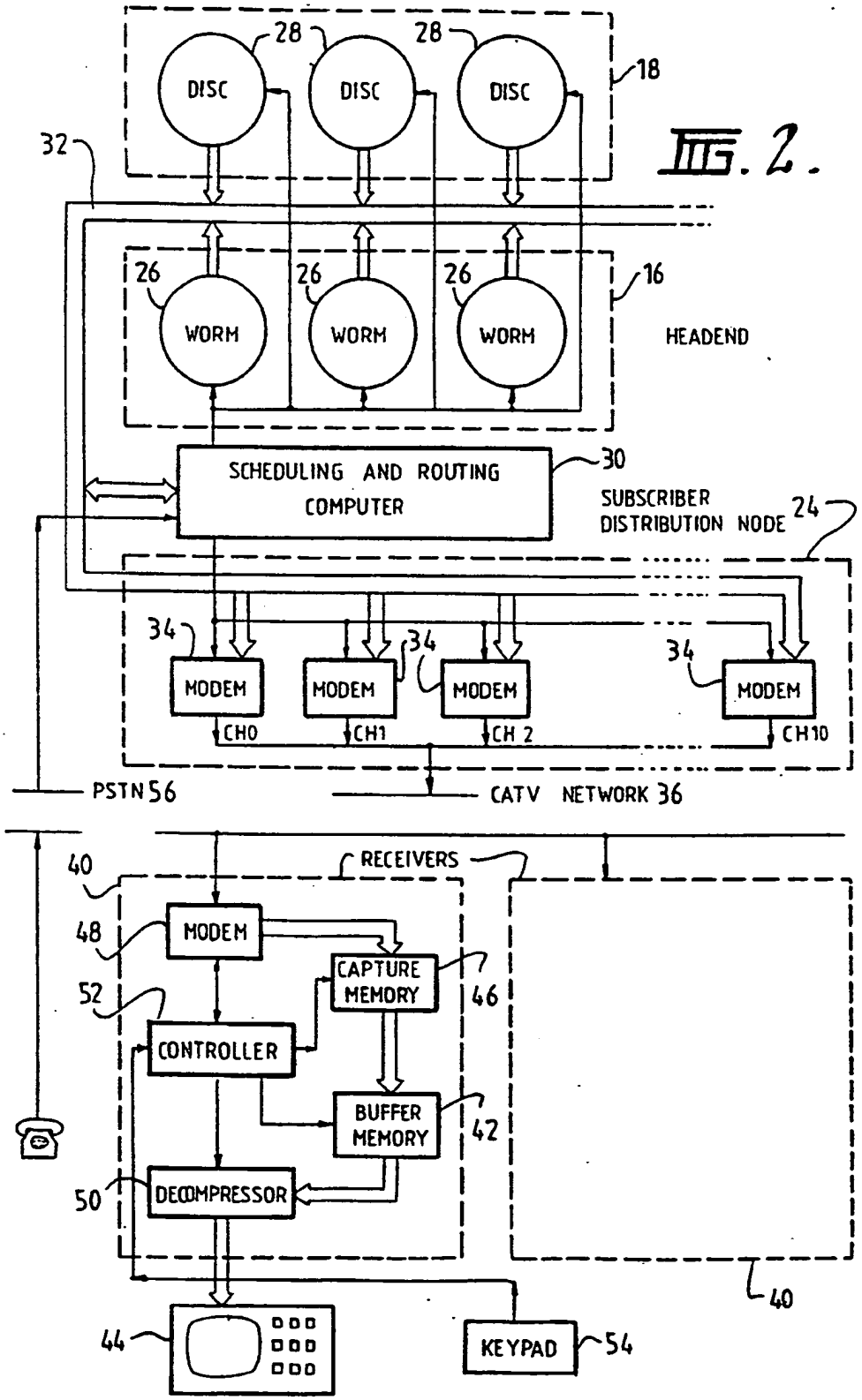
DISC
DISC
DISC
28
28
18
32
26
26
26
16
WORM
WORM
WORM
HEADEND
SCHEDULING AND ROUTING COMPUTER
30
SUBSCRIBER DISTRIBUTION NODE
24
34
34
34
MODEM
MODEM
MODEM
MODEM
CH0
CH1
CH 2
CH10
PSTN 56
CATV NETWORK 36
RECEIVERS
40
48
MODEM
CAPTURE MEMORY
46
52
CONTROLLER
BUFFER MEMORY
42
50
DECOMPRESSOR
44
KEYPAD
54
40

FIG. 2.

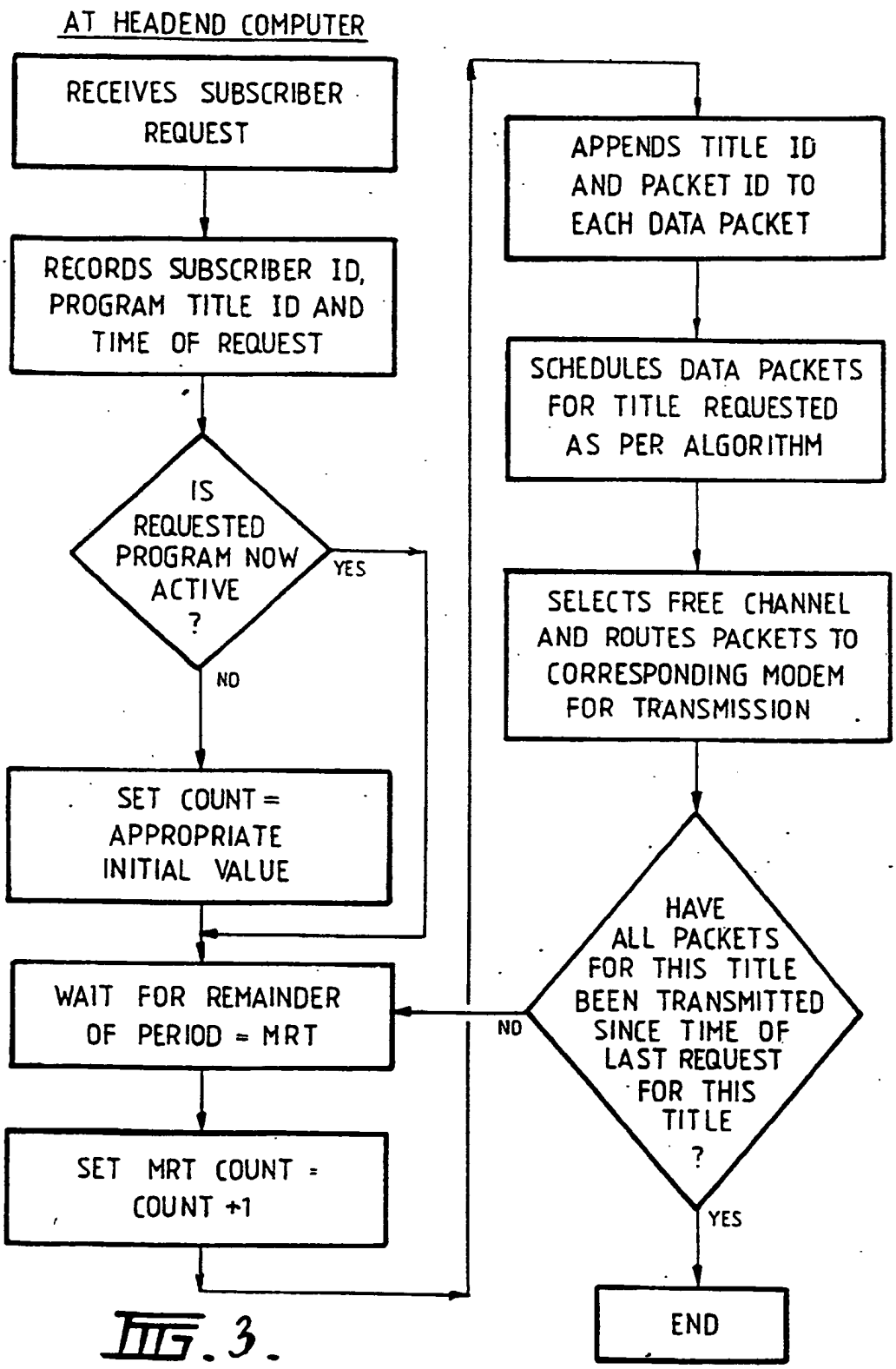
AT HEADEND COMPUTER
RECEIVES SUBSCRIBER REQUEST
RECORDS SUBSCRIBER ID, PROGRAM TITLE ID AND TIME OF REQUEST
IS REQUESTED PROGRAM NOW ACTIVE ?
YES
NO
SET COUNT = APPROPRIATE INITIAL VALUE
WAIT FOR REMAINDER OF PERIOD = MRT
SET MRT COUNT = COUNT +1
APPENDS TITLE ID AND PACKET ID TO EACH DATA PACKET
SCHEDULES DATA PACKETS FOR TITLE REQUESTED AS PER ALGORITHM
SELECTS FREE CHANNEL AND ROUTES PACKETS TO CORRESPONDING MODEM FOR TRANSMISSION
HAVE ALL PACKETS FOR THIS TITLE BEEN TRANSMITTED SINCE TIME OF LAST REQUEST FOR THIS TITLE ?
NO
YES
END

FIG. 3.

AT RECEIVER

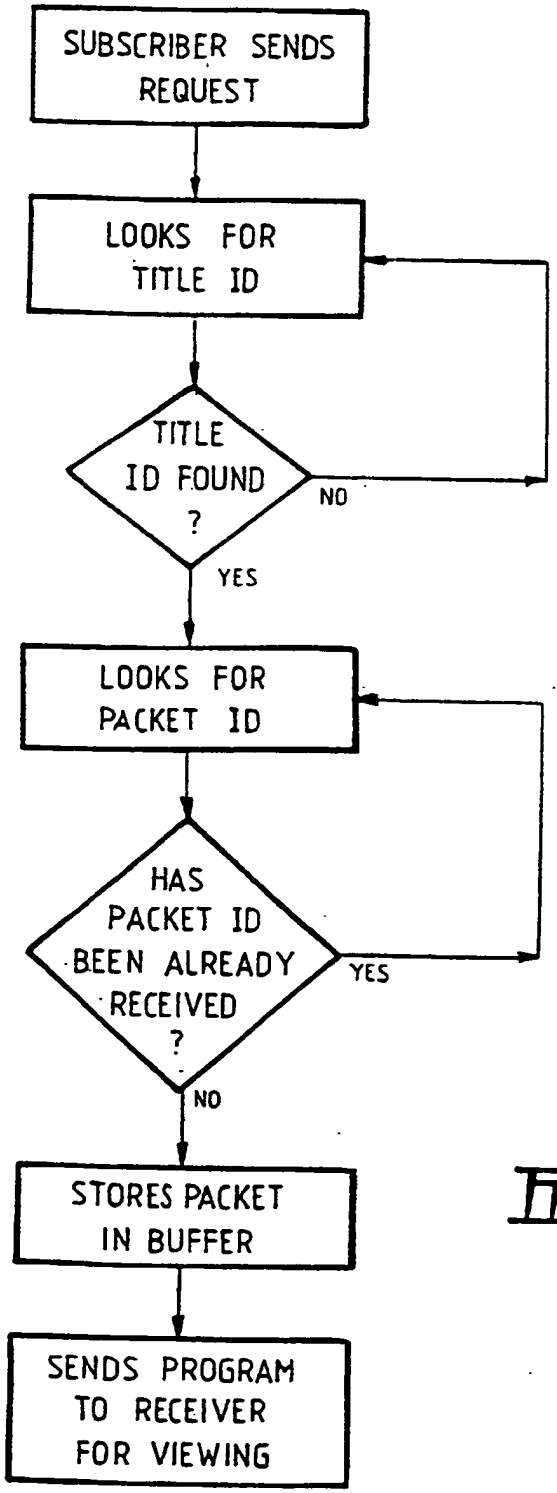

FIG. 4.

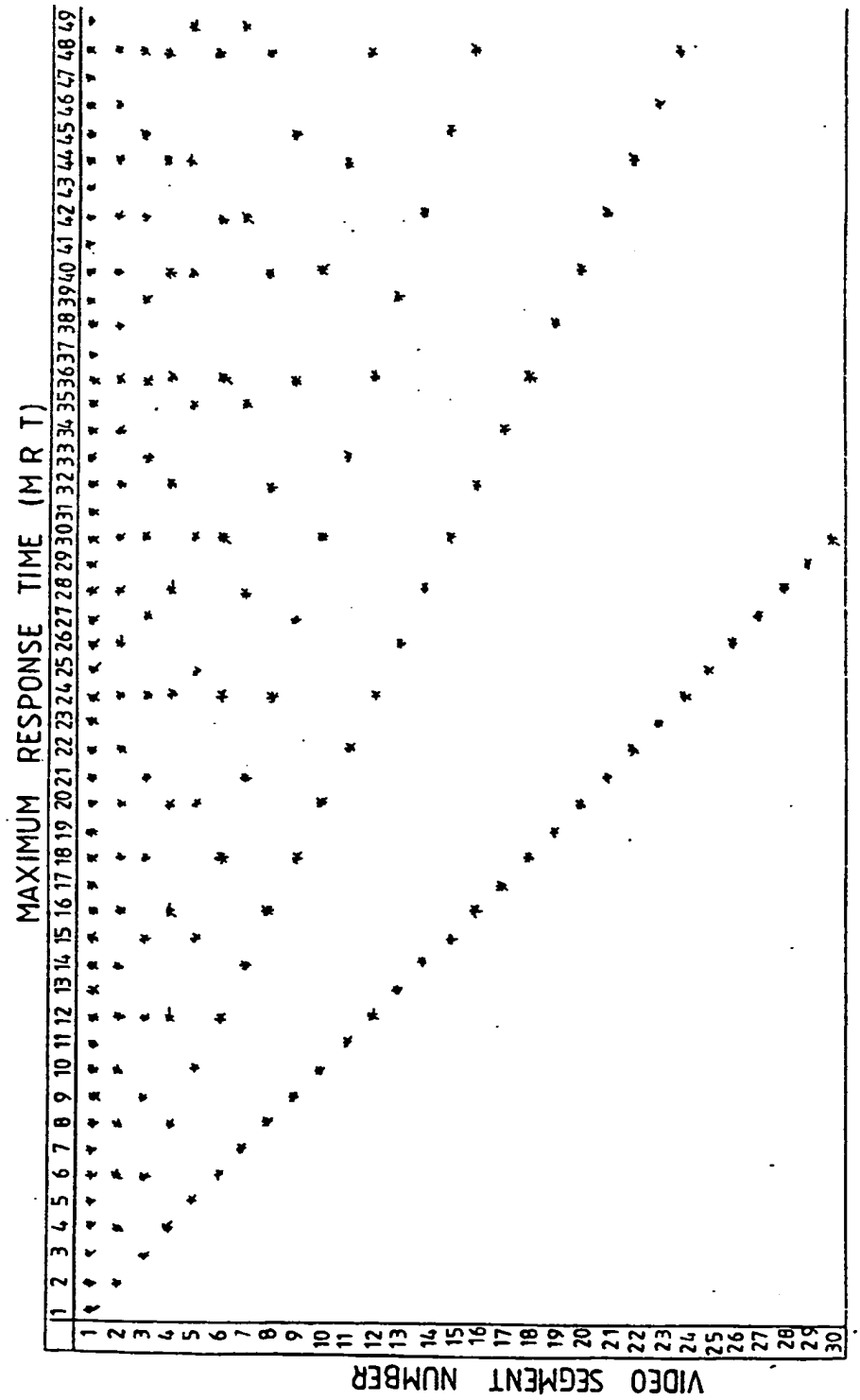
MAXIMUM RESPONSE TIME (M R T)
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49
VIDEO SEGMENT NUMBER
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

FIG. 5.

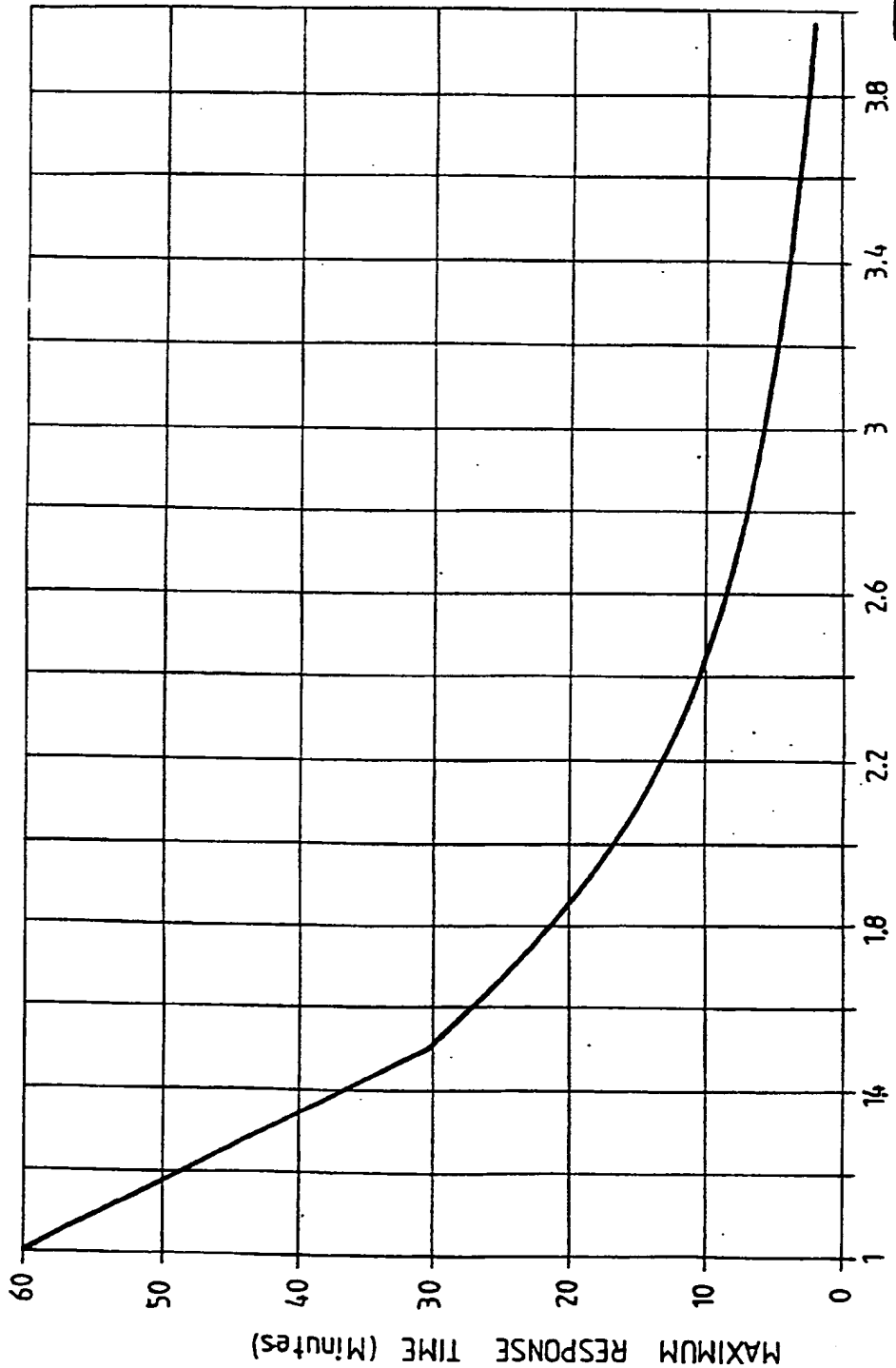
MAXIMUM RESPONSE TIME (Minutes)
60
50
40
30
20
10
0
REQUIRED VIDEO HOURS/HOUR (Multiples of VPT)
1
1.4
1.8
2.2
2.6
3
3.4
3.8

FIG. 6.

INTERNATIONAL SEARCH REPORT

International Application No. PCT/AU 90/00370

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 6

According to International Patent Classification (IPC) or to both National Classification and IPC

Int. Cl.[5] H04H 1/00, H04N 7/167, G11B 27/36

II. FIELDS SEARCHED

Minimum Documentation Searched 7

Classification System	Classification Symbols
IPC	H04H 1/00, H04N 7/16, 7/167, G11B 27/36

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 8

AU : IPC as above; Australian Classification 05.42

III. DOCUMENTS CONSIDERED TO BE RELEVANT 9

Category*	Citation of Document, 11 with indication, where appropriate, of the relevant passages 12	Relevant to Claim No 13
X	US,A, 4849817 (SHORT) 18 July 1989 (18.07.89) See Figs 5-7, column 8 line 60 to column 9 line 54	(1,8,13,16)
X	US,A, 4847690 (PERKINS) 11 July 1989 (11.07.89) See Figs 5-7, column 8 line 27 to column 9 line 21	(1,8,13,16)
X	US,A, 4821101 (SHORT) 11 April 1989 (11.04.89) See Figs 5-7, column 8 line 24 to column 9 line 18	(1,8,13,16)
X	EP,A, 343930 (SONY CORPORATION) 29 November 1989 (29.11.89) See Figs 1,6,9,11, page 5 lines 5 to 47, page 6 lines 16 to 29, page 9 lines 40 to 57	(1,8,13,16)
A	US,A, 4593318 (ENG et al) 3 June 1986 (03.06.86) See Figs 1,13 and Abstract (continued)	

* Special categories of cited documents: 10

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search	Date of Mailing of this International Search Report
9 November 1990 (09.11.90)	16 November 1990
International Searching Authority	Signature of Authorized Officer
Australian Patent Office	R. TOLHURST

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

A	US,A, 4887152 (MATSUZAKI et al) 12 December 1989 (12.12.89) See Fig 1 and column 1 line 40 to column 2 line 3	

V. [ ] OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE 1

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.[ ] Claim numbers ..., because they relate to subject matter not required to be searched by this Authority, namely:

2.[ ] Claim numbers , because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.[ ] Claim numbers ..., because they are dependent claims and are not drafted in accordance with the second and third sentences of PCT Rule 6.4 (a):

VI. [ ] OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING 2

This International Searching Authority found multiple inventions in this international application as follows:

1.[ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2.[ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3.[ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

4. [ ] As all searchable claims could be searched without effort justifying an additional fee, the International Searching Authority did not invite payment of any additional fee.

Remark on Protest

[ ] The additional search fees were accompanied by applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

ANNEX TO THE INTERNATIONAL SEARCH REPORT ON
INTERNATIONAL APPLICATION NO. PCT/AU 90/00370

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Members		
US 4849817	AU 11742/88	AU 29639/89	EP 279411
	JP 63226182	US 4821101	EP 326830
	JP 2192281		
US 4847690	AU 11753/88	EP 279410	JP 63231942
US 4821101	AU 11742/88	AU 29639/89	EP 279411
	JP 63226182	US 4849817	EP 326830
	JP 2192281		
EP 343930	AU 34972/89	EP 343930	JP 2096982
US 4593318	EP 130693	ES 533073	ES 8503465
	JP 60019375		
US 4887152	AU 10779/88	AU 597143	BR 8800343
	EP 277015	JP 63187984	JP 63209243

END OF ANNEX